THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 27. Thursday, May 10th, 1923. No. 351.

PUBLISHED WEEKLY.

Subscriptions Terms: 15s per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI,
LONDON, W.C.2.

Contents.

	PAGE
Standardisation and Foundry Progress	365
Some Characteristics of Moulding Sands and their Geographical Representation	366
An Apprenticeship Course in Foundry Practice.—XLII.	369
A Modern British Foundry	371
"Moulders" of the Industry	378
Correspondence	378
Catalogues Received	378
Institution of British Foundrymen	379
Comparison of Sand-Cast and Machine-Cast Pig-Iron	383
A New Synthetic Moulding Sand	383
Trade Talk	384
Company News	384
Gazette	384
Iron and Steel Markets	386

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institution of British Foundrymen.

PRESIDENT, 1922-1923, Mr. H. L. Reason, M.I.Mech.E., Holloway Head, Birmingham.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, 38, Victoria Street, London, S.W.1.
Lancashire: T. Makemson, 21, Beresford Road, Gorse Hill, Stretford, Manchester.
Birmingham: H. Roe, 62, Stanhope Street.
Sheffield and District: W. A. Macdonald, 62, Bannerdale Road, Sheffield.
Scottish: W. H. Bound, 69, Minard Road, Shawlands, Glasgow.
London: V. C. Faulkner, 21, Stanley Gardens, W.11.
Newcastle-on-Tyne: H. A. J. Rang, 2, St. Nicholas Buildings, Newcastle-on-Tyne.
East Midlands. H. Bunting, 17, Marcus Street, Derby.
Coventry: J. M. Meston, 37, Melville Road.
West Ridings of Yorkshire Branch: A. Love, 232, Gladstone Street, Bradford.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 20, Fisher Street, Swansea.

AT THE expiration of three months the names of the undermentioned companies will be struck off the Register of Joint Stock Companies, and the companies will be dissolved:—Acton Aluminium and Bronze Company, Limited, British Sheet Metal Company, Limited, Coal, Lignite and Peat Company, Limited, Enfield Machine and Auto Tool Company, Limited, Finedon Foundry Company, Limited, Guarantee Engineering Company, Limited, Harthope Lead Company, Limited, Hulme Engineering Company (Manchester), Limited, Lancashire Transport and Engineering Company, Limited, Lancaster Small Castings, Limited, London Emery Works (1921), Limited, Mahela New Steel Company, Limited, Moat Hall Colliery Company, Limited, Oil Fuel Engineering Company, Limited, Pelsall Wood Colliery Company, Limited, South Wales Boiler Scaling and Painting Company, Limited, Stannaries Metal Company, Limited, and Wallingford Foundries, Limited.

Standardisation and Foundry Progress.

Any comprehensive tour through British iron foundries could not fail to impress the most casual observer that an immense amount of research is being prosecuted in an unostentatious manner. We desire to include in the term research, carefully recorded knowledge, as it only requires interpreting and publishing to place it beyond the pale of argument.

With this work there obviously enters the question of standards, base lines or jumping-off points. The question of test bars has previously been dealt with in this column, and as the subject is in the melting point, and practically ready for teeming, it can be eliminated from any of the generalisations which follow. There are, however, materials other than the metal which require testing and a good deal of research work.

Sands, for instance, present a proposition of intense interest, both commercial and technical, for foundry men. The purchasing agent of any concern, if he puts up a reasonable specification to the iron founder, will either receive an intelligent criticism or acceptation. But suppose a foundryman issued a specification outlining the mechanical and chemical properties of the sands he wished to have in his foundry, the quarry owner would be perfectly justified at the moment in stating that it is not the custom of the trade to meet definite specifications. Obviously, if the trade as a whole co-operated to put the buying of sand on a common-sense basis, then the justification cited above would necessarily disappear. One important firm possessing a group of foundries has originated its own specifications—a lead well worth following by others—*but in co-operation*, as the standards on which these are based should be a *national* and not an *individual* affair. Another largely-used material is limestone, and every founder should realise that this material is not necessarily pure. It may, and often does, contain silica, and silica is just as useful in limestone as water would be in a load of coals. We have seen a load of coals sent back to merchant by a foreman on account of an exorbitant amount of water, and in the real interest of everybody concerned a truck of highly silicious limestone should be similarly treated. Apparently, this is another standard which should be dealt with collectively and in a general manner by the foundry industry, leaving each individual firm the right to specify the maximum he can allow. The main point is to make it enter as one of the *principal factors in the custom of trade.*

Finally, there is the question of foundry coke. Here again national efforts should be made to compel water, ash and sulphur content, mechanical strength and may be other properties to become essentials of the custom of the trade. There already exist specifications which, with slight modifications, would be suitable for national adoption.

In conclusion, we do not wish our readers to interpret this article to mean that we are in favour of specifying the maximum amount of sulphur and silica which foundry coke and limestone are to contain, if they are to be admitted into the foundry bins, but rather that foundrymen should procure the right to demand material to conform to *a specification* fixed by themselves, but the bases upon which these specifications would rest would be national in character. As examples of such bases, we would cite sampling, apparatus to be used and methods.

Some Characteristics of Moulding Sands and their Geographical Representation.*

By J. E. Fletcher (Dudley).

In the early days of moulding-sand research the author, with the help of his friend, Mr. Harry Brearley, employed subsidence tests to determine the mechanical and chemical characteristics of the sands and compositions employed at that time for steel-casting moulds. By shaking together definite quantities of water and sand in a standard test-tube or graduated jar and allowing the sand, silt, and clay to settle, the depths of the various strata were more or less clearly defined and, with the additional help of sieving, an index to the mechanical grading of the mixture afforded. Chemical analysis of the separated grades gave further information of very helpful character, and the method was used for years by the author before any published data on sand research were available.

More recently the very valuable researches of Professor Boswell here, and Messrs. Hanley, Simonds, Doty, Hall, Schwartz, and others in the United States, have enabled foundrymen to attack the moulding-sand problem with more scientific precision. Particularly in the matter of the determination of the size of the grains in the various grades constituting a moulding sand has the substitution of elutriation for subsidence methods of mechanical analysis proved valuable. The desirability, however, of some simpler and more direct method to indicate the characteristics of a moulding sand has been very generally recognised.

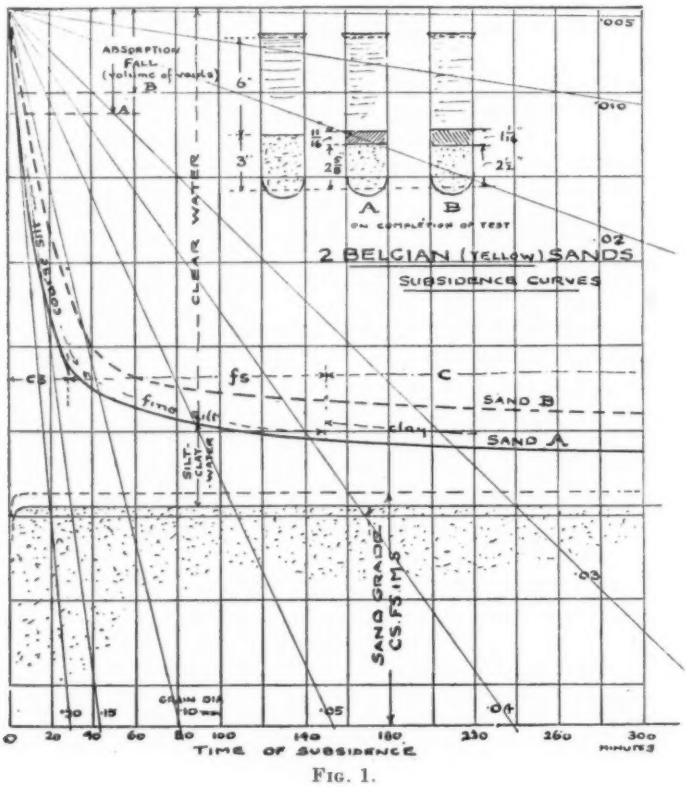


Fig. 1.

The Method.

For general handiness and practicability, test-tubes of 35 mm. (1½ in.) internal dia. and 230 mm. (9 in.) long have been employed.

The sand to be examined is slowly dried and passed through a 12-mesh sieve, fed into the test-tube slowly through a funnel, and gently shaken to a level of 3 in. above the bottom of the tube. Tap water, cooled to 15 deg. C. after boiling, is poured into the tube, covering the sand by a depth of 4 in. The water and sand are then vigorously shaken by hand—a method found more effective than mechanical stirring or whirling, and yielding more regular results. After shaking, the sand is allowed to settle in the vertical tube for, say, five minutes, when the water level will be found to have subsided by a definite amount, the new level remaining constant. The volume represented by the fall in the water level is a measure of the voids between the sand, silt, and clay grains, and furnishes an index of the type and openness of the grain packing, and also, approximately, of the gas permeability of the sand.

The tube is next filled to the brim with water at 15 deg. C. and shaken as before until, by a similar indication, mixture is effected. At the moment of complete mixture of the water and sand the tube is held vertically, and the time taken for the fall of the sand grades (C.S., M.S., and F.S.), the level of which rises until the sedimentation of these grades is complete, is noted. The moment chosen for the upending of the tube and its contents is the time taken as the commencement of the test, and the time taken for the subsidence of the sand grades affords a measure of the mean size of the grains in these grades. With some sands it is possible to time the sedimentation of two or three distinct grain sizes in this first subsidence.

The tube is next placed to rest in a truly vertical position, and the level of the silt and clay subsidence noted every one or two minutes for one hour, and, later, every ten minutes, until a stable

* A Paper presented to the Iron and Steel Institute.

level has been reached. As the silt and clay subside, the level of demarcation between the more or less clear water and the underlying mixture (silt + clay + water) is clearly defined.

The Subsidence Diagram.

On plotting the results on a time base, a curve characteristic of the moulding sand under test is obtained.

Fig. 1 gives the subsidence curve of a Belgian yellow moulding sand of similar chemical and mechanical analysis to that cited by Professor Boswell in his "Memoir on Sands," Part I., p. 62. Mean chemical analyses of the sand and clay grades gave almost exactly similar values to those of Professor Boswell, and in the case of other sands examined, the grade analyses of Wolverhampton, Kingswinford, French red, Cornish red, and Mansfield were very closely similar to those given in the Memoir referred to.

Such being the case, the comparison of the author's curves with the curves of cumulative per-

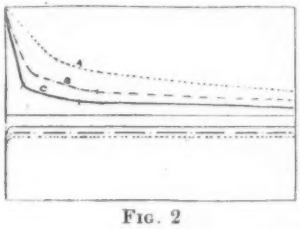


FIG. 2

centages of the various grades as prepared by Professor Boswell is interesting and practically useful. Whilst the latter show the percentage weight of each grade, the former illustrate in a striking manner the mechanism of the progressive subsidence of the silt and clay grades.

A closer examination of the subsidence curve in Fig. 1 brings out the clear differences in the two grades of silt and the characteristics of the clay grade. The effect of the silt grade in moulding

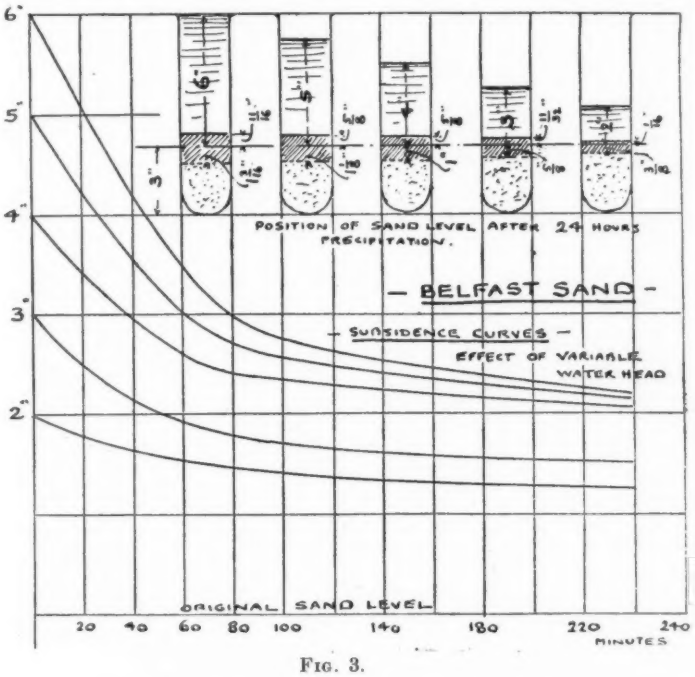


FIG. 3.

sands has long been recognised as being of vital importance: the lower the percentage of silt the better, and where present in quantity, the more uniform the size of the silt grain the more permeable the sand. A like condition in the clay grade is desirable.

Uniform size of the sand-grade grains is, of course, of primary importance, but as the gas permeability of a moulding sand is controlled by the type of grain packing, the effect of the silt grade, which so often mars the efficiency of an otherwise good sand, is well worthy of study. The author's curves indicate the mode of occurrence of the silt grade, and Fig. 2 has been prepared as indicating the three types of silt effect.

Curve A illustrates the presence of silts and clays of progressively diminishing grain size. It is somewhat difficult to say where the silt grade ends and the clay grade begins. Such conditions militate against good gas permeability, although the sand may possess excellent bonding strength. The curve is characteristic of several well-known sands rich in alkaline content. The silt grains are of small diameter.

Curve B shows two distinct types of silt grade, one of medium size, the other of fine texture. When this is noticed the clay grades are often present in two grades, differing in grain size.

Curve C is representative of some of the best moulding sands, there being only a small percentage of silt which, as in curve B, is divided into two distinct grades, each grade being of uniform grain size (the straight line portions being always indicative of uniform velocity of grain subsidence, and hence of grain size). The clay grade sedimentation is regular, almost a straight line throughout its length, indicating uniformity of grain size.

Porosity and Gas Permeability.

In a study of the grain pack, as H. A. Schwartz has shown, it is exceedingly difficult and unsafe to dogmatise on the relative volume of the voids in the sand-grade portion; but it is useful to remember that in the open, intermediate, and closest types of spherical packing, with spheres of equal size, the voids occupy approximately 47, 40, and 26 per cent. of the total.

It has already been stated that, in the author's subsidence tests, the amount of water absorbed by the sand during the first shaking up of the dry sand and water gives a clue to the percentage of void volume. This absorption volume varies, in the sands tested, from 30 to 40 per cent., approximately. It should be noted, however, that when the coarser sand grains are settling down and the air (churned up in the shaking) is escaping, the silt and clay particles are displaced and driven upwards by air and water currents. The absorption volume indicated by the drop in the water level is therefore a measure of the voids between the sand grains washed more or less clear from the silt and clay. When, after the second shaking, the sand, silt and clay again subside in the absence of air, each sand or silt grain is wetted, and the

velocity of fall is, proportionally, nearly in accord with Stokes's law for grains under, say, 0.10 mm. dia. (*i.e.*, directly as the square of the grain diameter), although more nearly agreeing with Boswell's corrected values, as ascertained from elutriation experiments. It is likely that the size of the tube used (35 mm. dia.) is smaller than that theoretically necessary for the unimpeded fall of the grains, but the trial of larger tubes did not appear to give superior results, and was not so handy.

Velocity of Grain Descent.

Reverting to the subsidence curves, it will be seen that three generally distinct angles of slope occur, each corresponding with the velocity of fall of three different grain-size grades.

In the earlier stages of the experiments the effect of varying heads of water above the sand level was noted. The variations in the curves obtained when 2, 3, 4, 5, and 6 inches respectively were added above a 3-in. sand layer are seen in Fig. 3. The sand tested was from the Belfast area and contained a high percentage of fine silt. The curves are steeper as the water head is increased.

It is clear that the amount of air churned up with the water before sedimenting (in this case the curves were taken immediately after the first shaking) has an effect on the rate of grain descent, the ascending air bubbles opposing the fall. The larger the volume of air in the mixture, the slower the grain-fall velocity. It is easy to observe in such tests the ballooning effect in carrying up with the air bubbles particles of fine silt and clay.

By filling up the tubes after the first shaking, and again allowing the sand to subside after a second agitation, regular results were obtained, the five curves being alike. It was, however, observed that in repeating the experiment with 2, 3, 4, 5, and 6 ins. of water head, the tubes being stoppered down to the water level so as to exclude air, the slopes of the silt grade subsidence varied, as in the first case, though not so markedly. One explanation of this variation in silt grain fall velocity would appear to be the coating of the silt grains by a clay film, thereby increasing the grain size and speeding up its velocity of fall. The deeper the fall, the greater the thickness of the clay film.

In foundry practice the addition of a fine fireclay to "used" sand in a well-wetted mixture brings about a similar grain growth, but here the great practical difficulty in obtaining homogeneous and uniform results is obvious. The author has noticed, in this connection, the rapid deterioration of synthetic sands made by mixing highly silicious sands with fireclays, when these have been allowed to lie unprotected from the weather. A few heavy rain-storms will soon ruin such a heap of sand. The "burning-on" troubles resulting from such an experience are not soon forgotten by the foundryman who has been unwise enough to use such sand without remilling and effective mixing.

In elutriation methods there is a possibility, when using water currents of excessive velocity, of reducing the grain size of sand covered lightly by the clay film. In some cases very misleading results have occurred. The author has noticed this scouring effect when sedimenting sands which have been repeatedly shaken.

Comparison of Theoretical and Actual Subsidence Diagrams.

As already stated, the subsidence curves at once give an index to the grain size. They also indicate the relative volumes of the various grades. The construction of a subsidence diagram from known data may throw light on the elucidation of the actual graphs presented.

A moulding sand may be taken as an example, having the following mechanical composition:—

	Per cent.
(*a*) Medium and fine sand grade (M.S. and F.S.) Average grain size, 0.25 mm. Subsidence velocity per sec., 25 mm.	80
(*b*) Coarse silt grade (c.s.) Average grain size, 0.10 mm. Subsidence velocity, 6.7 mm. per sec.	4
(*c*) Fine silt grade (f.s.) Average grain size, 0.025 mm. Subsidence velocity, 2.5 mm. per sec.	6
(*d*) Clay grade (c) Average grain size, 0.007 mm. Subsidence velocity, 0.05 mm.	10

In Fig. 4, the water and sand being thoroughly shaken together, the various grains are assumed to be uniformly distributed within the water mass. Also velocities are assumed to be constant throughout the grain-fall period in the case of each grain grade.

In A, B, C, and D the lines *xp*, *xq*, *xr*, and *xs* give the slopes corresponding with the velocities of the grains in each grade. At the end of the descent of each grade the upper surface of the sedimented matter is shown at levels *p*, *q*, *r*, and *s*, and in D the progressive curve of the subsidence is given—P*qrs*—on the assumption that each grade is sedimented separately without admixture of any other grade. By estimating the voids in each grade as 40 per cent. of the total grade volume, it is possible to trace the progress of the subsidence at the completion of the sedimenting of the various grades. The free water above the already sedimented grades can be estimated, and the ratio R of free water to depth of sediment arrived at. The curve of these ratios, starting from the end of the clay grade, marked *s*, *m*, *l*, *x*, will be found to approximate to the subsidence curve obtained by actual observation.*

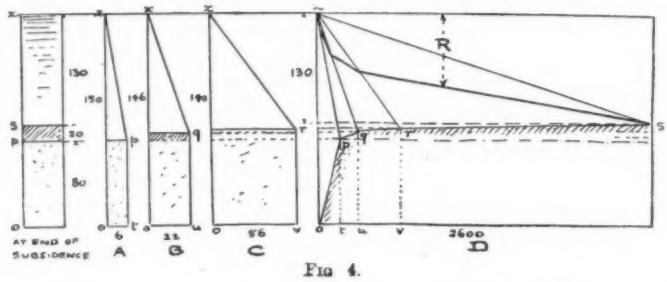


FIG 4.

(To be continued.)

Canadian Costs of Iron and Steel Production.—Indications are in the direction of higher costs in the production of pig-iron and ingot steel in Canada. Lake ore prices are stated to have been established for the year at an advance of 50 cents (say 2s. 2d.) a ton over 1922 prices. Another factor is the wage advance to both common and skilled labour, which became effective on April 1. Large numbers of both common and skilled workers are leaving Canada for the United States owing to the restriction of European immigration into the latter country, and to the demand for labour caused by the trade revival. Scarcity of steel is now the prospect confronting industrial works in Canada. While there are large tonnages on order, and warehouses have stocks sufficient to meet seasonable requirements, it is predicted that by July next the trade will be run on a hand-to-mouth basis. Price advances at the end of March included a rise of $1 per ton on pig-iron to $36.55 154s.) at Toronto and $38.90 (164s.) at Moutreal for best foundry grade.

Ilva Company.—This concern reports profits for 1922 amounting to 3,750,000 lire (say £37,500). Two furnaces have been blown in at Portoferraio, the only two said to be in blast in Italy. The two furnaces belong to the Elba Company, a concern closely connected with the Ilva Company. The latter concern has started rolling shapes and rails at their Piombino works. A dividend of 7 per cent. is to be paid.

* A comparison of the curve *pqrs* with Professor Boswell's cumulative curve for the sand is of interest.

An Apprenticeship Course in Foundry Practice.—XLII.

By Ben Shaw and James Edgar.

SETTING OUT AND DETERMINING THE CONSTRUCTION OF A LARGE PATTERN.

It is not usual to give an apprentice pattern-maker a drawing for a large job on which several men will be employed and allow him to take full control. It is very unusual indeed for an apprentice to get the opportunity of assisting in setting out large work. This, up to a point, is understandable, but it is nevertheless regrettable. Not only great accuracy, but great experience is necessary. It is so easy to make a mistake which will lead to a big constructional error which if it does not cause the scrapping of the pattern will cause much labour in making it right.

The apprentice should watch the methods employed by the most experienced men. There are some patternmakers who can set out a large job in a fraction of the time that others would take, but their speed may mean an ultimate loss. A drawing should be so clear that it ought not to be necessary for the men working on it to require explanations.

The best practice for setting-out large jobs is undoubtedly setting-out small work, but it frequently happens that a man may be quite good at the latter yet fail palpably at the former. It is to a great extent a question of confidence.

Boy Charge-hands.

There are shops in which the practice is to give apprentices in their last year an opportunity to set out and take charge of large jobs, and it proves of great value to them. In other patternshops a boy may be put on to assist the charge-hand, and his work consists of steadying trammels, holding a straightedge and setting out simple parts of the board. This is excellent training and the apprentice should make the most of it.

In an early article of this series we discussed very fully the reading of drawings, and there is no need to refer to the subject here except to say that the patternmaker who cannot read a drawing cannot set out the work. This may seem the reiteration of the obvious, but it is not uncommon for men to begin setting out when they have only a confused idea of the design of the pattern they are going to construct.

Replacing Old Castings.

It sometimes happens that a pattern has to be made from an old casting. It may be possible with medium sized work to have the casting brought into the pattern shop and placed alongside the drawing board, but it is more often necessary to go to where the casting is lying and make a dimensioned sketch, from which a proper drawing can be made. Sometimes, in order to economise time, the sketch has to be made under very awkward conditions before the casting has been dismantled. Even when the casting is in the patternshop it is wise to make a sketch or sketches first. As a general rule it is advisable, when there is difficulty in measuring the thickness of a wall of metal, to err on the safe side. The cause of the defect should be inquired into. In nine cases out of ten when there is no noticeable flaw in the metal a fracture is due to some fault of design, and it is the patternmaker's business to investigate this, and either by increasing the thickness of metal or by ribbing, to prevent a recurrence of the trouble.

It is quite wrong to suppose that, because work is being made from an old casting, it is not necessary to be as careful when setting down. Some patternmakers make what may be described as a rough drawing from a casting—probably only one view—and use the casting for comparison as the work proceeds. This is bad practice, as great care should be exercised to ensure that a drawing for a replacement is as accurate and as complete as for a new job. After the drawing has been made it should not be necessary to again refer to the casting.

Number of Views.

In all patternshops there is a number of drawing boards of various sizes. When the craftsman gets a drawing for a large job he should first spend an hour or two getting a broad understanding of the outlines. The really experienced man has usually determined, in a general way, the construction of the work before he puts a line on the drawing board, but the apprentice may be content if he knows what he is going to make. The preliminary examination should determine the number of views that it will be necessary to set out. For some large work of plain design only a plan or elevation is necessary, in other cases two views are advisable, while in some cases it may be necessary to set out an elevation, a plan, an inverted plan, end views and sections. Cores have much to do with the number of views necessary, and it very often happens on a large job that many scrap views and sections may have to be set out as the work proceeds. It is almost impossible, say in the case of a large cylinder, to get all the necessary views on one drawing board.

Preparing Drawing Board.

Having determined upon the number of views that will be necessary, the size of the drawing board can be decided. To set out the various views of a large pattern in their correct relative positions, as on the blue print or tracing, is seldom practicable. In many cases the drawing board has to be sent to the foundry with the pattern as an aid to the moulder when setting cores and testing metal thicknesses, therefore it must be of reasonable proportions. On the other hand, in the patternshop it would be decidedly inconvenient if a drawing board were so large that men had to climb on top of it to get dimensions. Another objection is that it is seldom that there is sufficient floor space for a very large drawing board in the patternshop. For these various reasons a comparatively small board would be used and the various views would be drawn on top of each other and metal thicknesses coloured to avoid confusion.

It is very important that all old lines should be planed out or obliterated before a new drawing is set out on a board. It is also important, if a try square is going to be used, to straighten the edge carefully. This injunction is necessary because drawing boards are used repeatedly in some patternshops without the edges being tested. The edge of a drawing board is as important as the centre line.

As it is not desirable to plane out a drawing until the last casting has been actually machined, patternshops have to carry many more drawing boards than are in use, and to keep the number as low as possible it is quite common practice to use both sides. The battens are, one at a time, transferred to the opposite side of the board and in the event of another casting having to be made the board is available. Drawings, whether for large or small work, should be kept until the final casting is finished.

Overhauling Drawing Tools.

Having prepared a drawing board, it is essential that the various drawing instruments should be overhauled. Even if the try square is not used for all cross lines it is just as well to have a straightedge on the board as it is very convenient to use the try square for lines that are not the full width of the board. With regard to straightedges, these should be tested carefully before beginning to set out. For the drawing board it does not matter whether the edges are parallel. One straightedge should be at least the same length as the board, but one or two other straightedges of shorter lengths are also necessary.

Trammels are of all sizes and sorts. It is very seldom that a satisfactory pair of trammels is to be found. Either the trammel heads are exception-

ally heavy with a very light stick, or the stick is too heavy for the heads. It is quite impossible to make an accurate drawing with a trammel stick slim in proportion to its length. There should be no yield. Trammel points are invariably too long. Some craftsmen point both heads, but it is much better, even with small trammels, to give one head a chisel edge: not a wide chisel edge but just sufficiently so that it will cut and not tear the surface of the board. A sharp point follows the grain of the timber and a chisel edge is not as liable to do so. It is possible to have the edge too sharp. A trammel so sharpened that the line drawn by it cannot be seen is useless.

What is true of trammel points is also true of compasses. The apprentice may be urged, however, to use trammels in preference to compasses and never to use spring dividers for drawing circles, which is very common practice. With regard to marking knives, some prefer the knife ground on one side only, but greater care is necessary in its use as it is liable to slice the straightedge. The knife should be used for all lines across the grain of the timber, while the point should invariably be used for lines that follow the grain of the timber. Having prepared the drawing tools it is now necessary to make length rods. We have previously dealt with length rods, so it will be sufficient here to say that all important centres should be marked on the length rods, after which their faces should be varnished or by repeated handling it may be difficult to see the marks on the rod after it goes to the foundry, and length rods are invariably sent to the foundry. Too much care cannot be expended on the length rods. In very large castings it may be necessary to vary contraction allowances for length and height and width, and this is determined when making the length rods.

Centre Lines.

With regard to centre lines it is usually advisable to draw the main longitudinal centre line first. This, in the case of a narrow board, may be done by means of a final gauge from the edge, but more often a straightedge is used, points an equal distance from the edge having previously been marked. The main cross centre should be drawn geometrically, after which other centre lines can be set down with trammels and straightedge. We are describing this process because method is quite necessary in setting down work, and the apprentice or young journeyman who becomes accustomed to a methodical procedure realises its importance later on.

When all the important centre lines have been set down, it is wise to check them from the drawing before starting a view. The elevation is usually the most important view. Although one view should be finished before another is started, it is as well when trammels are set to a certain dimension to transfer the dimension to the plan. Thus, in the case of a plain cylinder, a longitudinal section and a cross section would be drawn, and while the trammels were set to the radius for the elevation the cross section should also be drawn.

To make a neat and clean drawing, as few lines as possible should be lined in before a whole view has been finished, and no view should be coloured until the whole drawing is complete. All machined faces should be shown, and if camber has to be allowed the pattern should be drawn to the camber shape. In short a workshop drawing should show the work as it will leave the patternshop. It is quite futile to set out work if additional allowances have to be made when constructing the pattern or coreboxes.

Construction Lines.

During the course of construction it is necessary to lay down additional lines showing timber joinings and divisions of cores. Extra lines of this kind should be as few as possible because a dozen or more men may be working from one board and if all are allowed to set out constructional lines the value of the drawing will be considerably reduced. The one who has set out the work in the first place should be the only one allowed to put additional lines down. Unless when it is necessary to develop a shape geometrically and when it can be much more easily done on the main board, constructional views should be set out on separate small boards.

When the various views have been set out and coloured, different colours being used for each view, the construction has to be decided upon. In regard to colouring the views, it is chiefly necessary to distinguish between the various sections, thus the metal of one may be coloured red, of another yellow, of another green and so on. Boards should be varnished before the work is started. Some patternshops neither distinguished the separate views by colouring, nor varnish them, but it is slovenly practice not to do so.

Deciding Construction.

It is impossible to start a squad of men on a large job until the construction has been thoroughly considered. Details may, of course, be left in many cases, but it should be remembered, that what may appear cursorily to be of minor importance, may have a very important bearing on the construction, and neglect of its consideration at an early stage may necessitate modifications later on. It is as well therefore not to overlook even the smallest details. The foreman in most cases decides on the construction of a large pattern, but the craftsman should ascertain himself to consider it as though he himself had to decide definitely. Some parts of the job may offer several alternative methods and it is not always an easy matter to decide which is best. Moulding has to be considered and difficulties in machining the castings may have to be overcome by slight modifications of details. It is occasionally necessary to have a conference of patternmaker, moulder and machineman.

The neophyte usually finds difficulty in so regulating the progress of a large job that there is no waiting on the part of the men who are actually erecting the work. In some shops it is customary for each man as he makes a part to fit it and secure it in position. Better results are obtained, however, when two men build the work and they are fed by the rest of the squad. If the job has been properly set out and care is taken by the men making the various parts very little tool work should be required when erecting.

Cutting Timber.

A custom which is not as common now as formerly, was for the man in charge of a large job to break out all the timber. So expert can one become with practice that the smallest bosses and prints can be rough cut. There is very little waste when this practice is adopted because ends and corners that would be thrown on the scrap heap are used for small ribs, bosses and prints. The apprentice should accustom himself to getting out all the timber for a job at the beginning, as it also ensures that he has a thorough grip of the work.

When erecting a large pattern, the main body must be set down to centre lines on the floor or on the skids first. Small blocks or buttons will keep it firmly in position. It is a good practice to set down centre lines and also lines representing flange faces, etc., on the floor so that when branches or other parts are fitted a plumb bob may be used for testing. The plumb bob and the level are invaluable when building large patterns, and much more reliable than the try square or set square used from adjacent faces or from the floor.

When constructing large patterns, parts that the moulder will have to loosen off should always be screwed in such a manner that the moulder will have no difficulty in releasing them when the pattern is in the sand, and it is imperative that all screws should be greased so that they will unscrew readily. This may seem a minor point but it is really very important.

Testing Work.

There cannot be enough testing and measuring when building a large pattern. Length rods and rule should be continually in use and each part, be it only a small boss, should be tested in every way possible. It is only by practising good methods that skill in constructing large patterns can be obtained. Nine out of ten apprentices do not get the opportunity to set down or construct large work, but many do not avail themselves of such opportunities that offer, and a great deal can be learnt by close observation.

A Modern British Foundry.

Undoubtedly, one of the most interesting foundries in Great Britain is that of A. Harper, Sons & Bean, Limited, an old-established firm, founded in 1826. This concern has a world-wide reputation as the manufacturers of the "Bean" car, and although they are very often mistaken for a financial corporation—Harper Bean, Limited—they are an entirely separate undertaking. It is true that Messrs. Harper Bean, Limited, have an interest in A. Harper, Sons & Bean, Limited, but they do not control this company; the majority of the shares in A. Harper, Sons & Bean, Limited, are held by the Bean family and Messrs. Hadfields, Limited, of Sheffield.

A general idea of the foundry will be gained from a study of Fig. 1, which shows that the aim of the designer was elasticity. By this we mean that the manufacture of any speciality can be kept in one bay to itself. The foundry, a general view of which is shown in Fig. 2, is 360 ft. long by 170 ft. wide, and is divided into five bays. The foundry has been planned on a very large scale, and when working at full capacity is estimated to be capable of an output of 20,000 tons of miscellaneous castings per year, the bulk of which would be of that high class character associated with automobile work.

Transport Arrangements.

The external transport arrangements have not yet been completed as originally planned, as there still remains the construction of a bridge over the canal. When this has been done it will allow of the installation of material-handling devices, which at present are of the usual order. Internally the transport problem is tackled by eight 5-ton and one 15-ton electric cranes by Mesrs. Broadbent, of Huddersfield. These are supplemented by numerous jib cranes.

Pattern Shop.

Owing to the extensive ramifications of the concern, the pattern shop does not come within the foundry organisation. From a purely foundry point of view this is considered as a defect, as it makes the close co-operation more difficult. It will be noticed from Fig. 1 that no blower house is shown. This shop, together with the compressor house, metal pattern machinery and fitting shop, plant maintenance shop, foundry offices, pattern stores and laboratory are situated in a separate building.

Blower and Compressor Houses.

Blast is provided by two Roots' blowers, by Messrs. Thwaites Brothers, of Bradford, of a total capacity of 1,200,000 cub. ft. of air per hour. They are driven by 60-h.p. Westinghouse motors. Compressed air is provided for the numerous moulding machines by Reavell compressors.

Pattern Stores.

This department is situated on the first floor of the auxiliary building. The system adopted has been to provide a number of main rack standards, which are alphabetically indicated. Each standard is divided into 12 numbered compartments. Thus if the pattern-stores inventory shows that a certain pattern bears the number E6, then it is to be found in rack E, compartment 6. When a pattern is received into the stores it is entered up into the store book, the setting out of which is shown in Chart I.:—

CHART I.—ARRANGEMENT OF PATTERN STORES BOOK.

Customer's Name and address.	Pattern No.	Description.	Quantity and material.			Rack.	Date received.	Date returned.	Remarks.
			Patts.	Core boxes.	Loose boxes.				

Plant Maintenance Shop.

It was with interest that we noted that the onus of the upkeep of the foundry plant is thrown upon the foundry manager, and the general smartness of the whole foundry shows it to be a system worth while adopting by other large concerns, as obviously the works engineer has not the same interest in the maintenance of foundry plant as the foundry manager.

Melting Plant.

The metal is brought down in five cupolas—three No. 5's and two No. 6's, all of Messrs. Thwaites' manufacture. Raw material is raised to the charging platform by two lifts driven by 9-h.p. motors. All the coke is kept under cover. For cylinder work 5-cwt. charges are used, but 20 cwts. are drawn off at a time. In order to ensure that cylinder mixtures shall not be contaminated by other mixtures, no drastic changes of composition is allowed in consecutive mixtures, but a dividing charge is used. Mr. J. W. Richards, the foundry manager, insists that casting temperature is one of the most important factors governing the soundness of cylinder casting, and special attention is given to the method of controlling it. Much semi-steel is used in this foundry.

Sands.

Whilst the bulk of the work is made in green sand, dry sand and loam moulding is also practised. The general lay-out of the sand-preparing room is shown in Fig. 1 in Bay No. 1. The sand is first milled in an overhead geared plant made by Messrs. Evans, of Manchester, and is then passed through a mixer. This machine, made by Messrs. Alfred Herbert, Limited, of Coventry, is designed for the purpose of aerating the sand. Whilst some founders may deem it to be extravagant, the A. Harper, Sons & Bean management consider it economical to use oil-sand cores for quite large castings. The results obtained by the use of oil-sand apparently justify their claim. They attach much importance to the correct mixing of the sea sand with oil.

Oil Sand Mixer.

Mr. Richards has devised and patented in conjunction with the firm the oil-sand mixer shown in Fig. 3. From this illustration it will be clear that a right and left-handed screw mounted on a common shaft are operating to force two streams of sand into one. The capacity of the machine our representative saw operating was 1½ cwt. Using Spermoline oil the sand and oil were thoroughly mixed and ready for use in 4½ min. As the mixer has achieved good results, the firm have decided to place the machine on the market. It is covered by Letters Patent No. 18423/22.

Moulding Machines.

The foundry is equipped with no fewer than 33 moulding machines, the disposition of which is shown in Fig. 1. At the time of our visit, Britannia machines were being used for pistons, special pipes, and small parts in general. Five Adaptable machines were exclusively engaged upon the production of air-cooled motor cycle cylinders, the fins of which are moulded by means of a special stripping plate. Fig. 4 shows the moulder tucking the sand in between the fins, and in Fig. 5 the cleanness of the draw is specially noticeable. In Fig. 6 core is being placed in position. The method of running is clearly shown.

Five Tabor roll-over, pattern-drawing machines are used for making Bean car and other cylinders. One of these is illustrated in Fig. 7, engaged upon the moulding of a Bean cylinder. Wherever possible, the foundry management prefer to use metal patterns for such jobs as this, but where difficult metal reinforcements are inserted in places where wear is likely to take place. The core-making for the Bean engine is shown in Fig. 8, and the insertion of the cores in Fig. 9. Two large Osborne machines are used for the cylinder and crank case blocks, whilst two small ones are engaged upon small work. Other small work is tackled by Mumford squeezer machines.

Three Grimes moulding machines are used for pipe-core making. A vibrator attachment eliminates rapping and insures a steady draw.

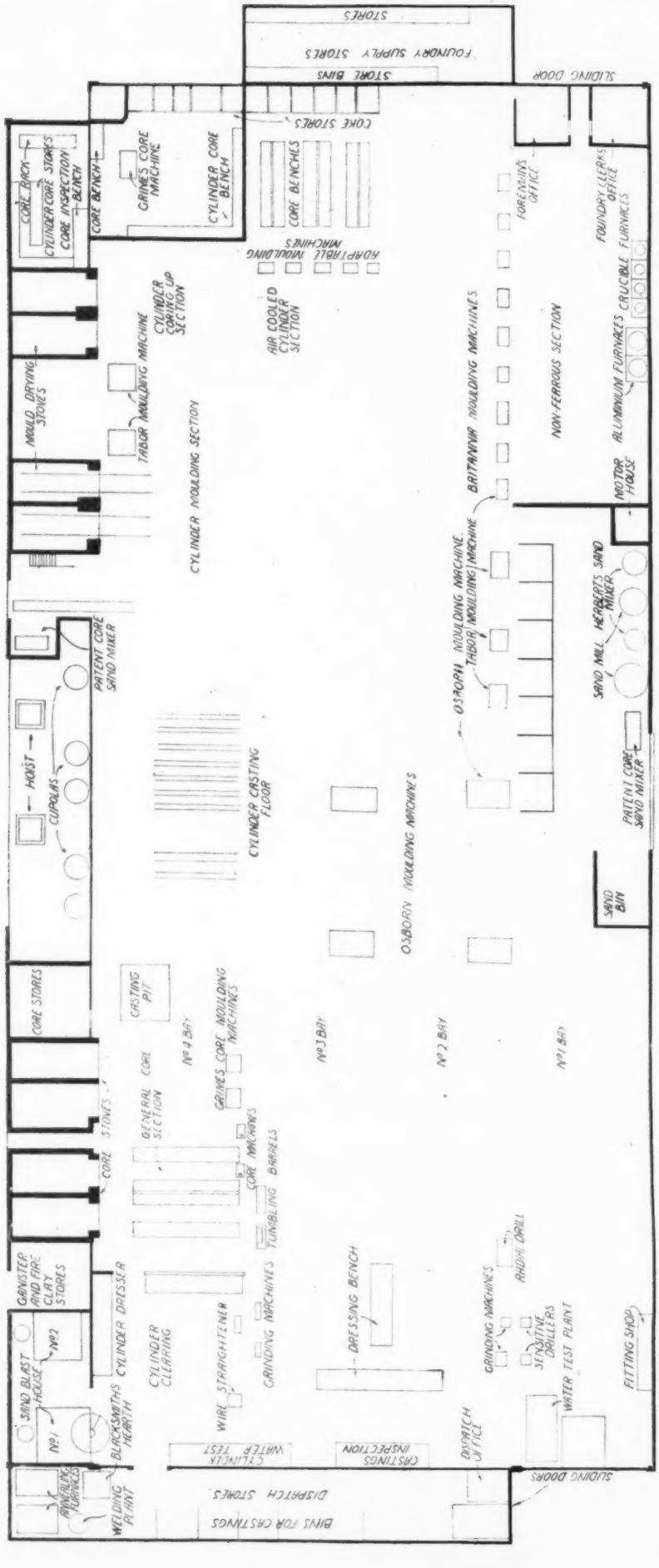


FIG. 1.—LAY-OUT OF MESSRS. A. HARPER BEAN & SONS' TIPTON FOUNDRY.

XUM

A MODERN BRITISH FOUNDRY.

Messrs. A. Harper, Bean & Sons, Limited.

See pages 371, et seq.

Fig. 2.—A View of two of the Bays of the Foundry, detailed in Fig. 1.

Fig. 10.—The Foundry Laboratory, the work of which is supplemented by the Works General Laboratory.

A MODERN BRITISH FOUNDRY.

Messrs. A. Harper, Bean & Sons, Limited.

See pages 371, *et seq.*

Fig. 4.—Moulding a Motor Cycle Cylinder the fins of which are stripped through the plate.

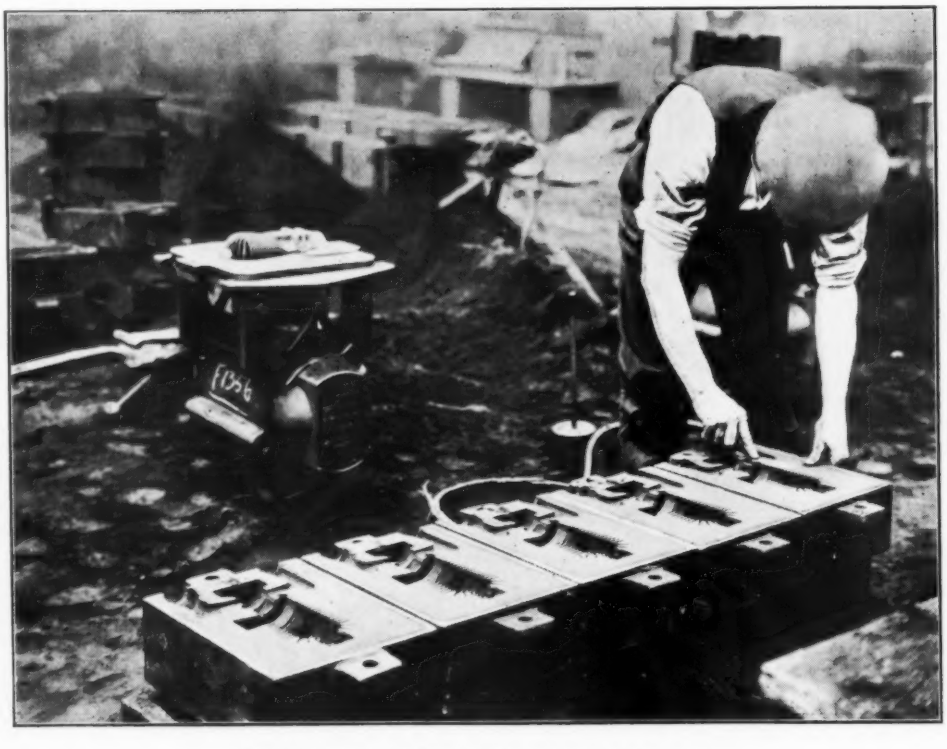


Fig. 5.—Motor Cylinder Moulds ready for the Cores.

A MODERN BRITISH FOUNDRY.

Messrs. A. Harper, Bean & Sons, Limited.

See pages 371, *et seq.*

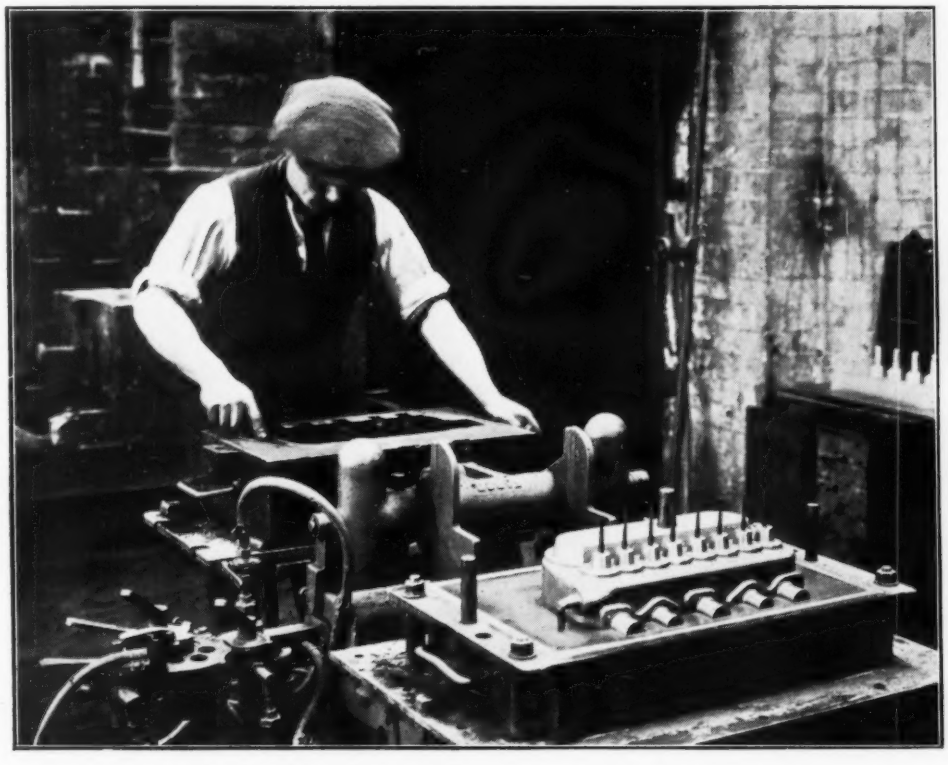


Fig. 7.—Making Bean Car Cylinders on a Turnover Machine.

Fig. 8.—Core Making for the Mould illustrated above.

A MODERN BRITISH FOUNDRY.

Messrs. A. Harper, Bean & Sons, Limited.

See pages 371, *et seq.*

Fig. 11.—Illustrates the variety of Automobile Castings made in the Tipton Foundry.

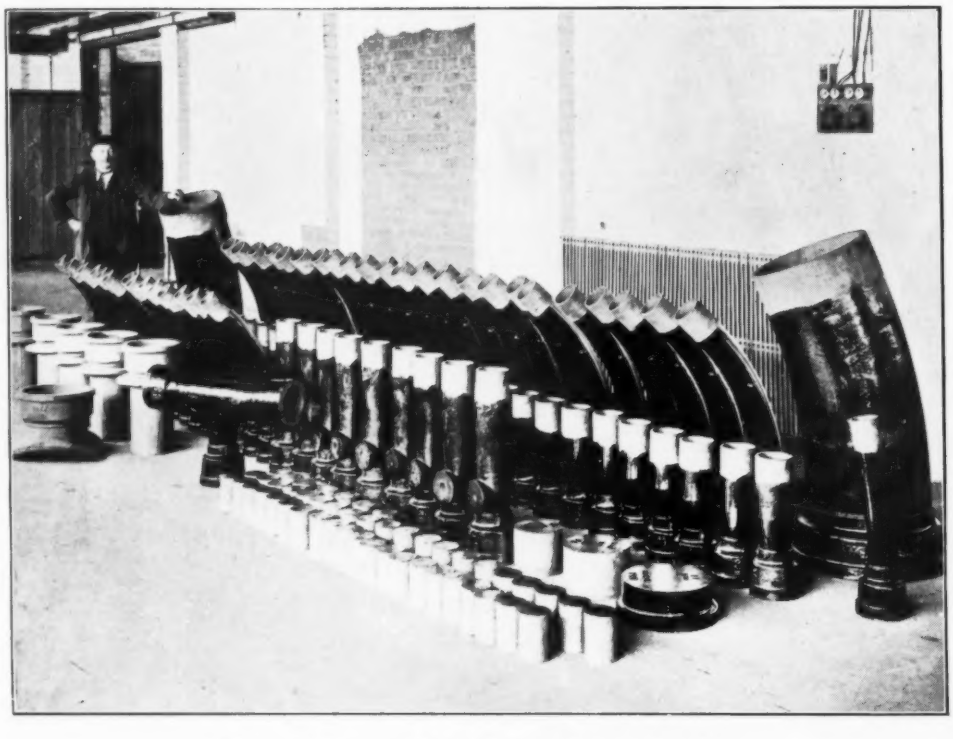


Fig. 12.—A Group of Special Pipes made in the Foundry.

It is interesting to note that two men and a lad make 35 three-part moulds per day on the two Taber roll-over machines.

Mould and Core Drying.

The mould and core-drying stoves are of their own design. They are Mond gas-fired, and are provided with Kinnear shutters. The drying of

FIG. 9.—COREING UP A BEAN CYLINDER MOULD.

small cores is tackled by a battery of 15 Goodyear stoves.

A comprehensive picture of the whole foundry is difficult to obtain, as it is divided into a number of bays. However, some idea of its aspect will be gained from Fig. 2. Amongst the special features noted was the excellent system of providing compressed air and Mond gas everywhere. Mond gas is used for warming pattern plates, skin-drying moulds, and also in the various ovens and furnaces. Compressed air is used for sand blasting, moulding machines and everywhere replaces bellows.

In addition to automobile work, the firm do a general ironfounding business, amongst which class they have built up a large turnover in special pipes railway work and ingot moulds for copper.

Fettling Department.

In a foundry of this type it is best to house the fettling department under the same roof, near to the despatch department. Amongst the plant utilised are two modified Tighman sand-blast plants of the cabinet type, several tumbling barrels, a variety of grinders of their own design and manufacture, this being a speciality of the company.

Inspection.

Near the despatch stores (Fig. 1) is the water pressure testing bench. Here all cylinders are proved before leaving the foundry building. Additionally a hammer test is carried out to discover if any subcutaneous defects are present.

Control.

It has recently been stated that scientific control in foundries is 90 per cent. nonsense. Who originated the statement we do not know, but we are convinced that a visit to Messrs. A. Harper, Sons & Bean's foundry would make him reduce his figure considerably. All materials are analysed in the laboratory shown in Fig. 10, and should any figure require checking there is a large general laboratory available for this purpose and for research. Then, again, not merely are all raw materials analysed but representative mixes carry-

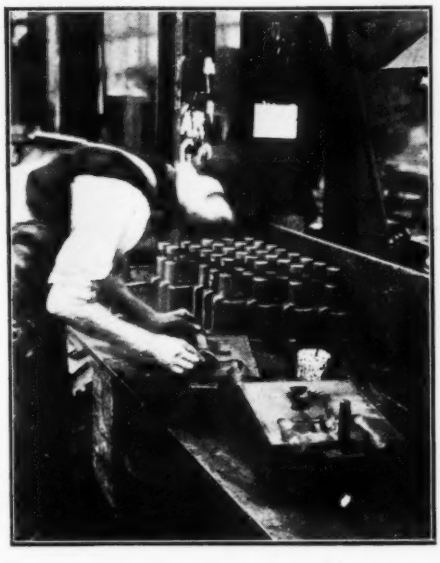


FIG. 6.—PLACING THE CORES INTO MOTOR-CYCLE CYLINDERS.

ing a number are carefully weighed out and put through the cupola as trial casts. The analysis of each mix is established as far as is humanly possible.

As the manufactures of the foundry range in weight from a few ounces up to 15 tons it is difficult to show a representative group. However, the castings shown on Figs. 11 and 12 indicate castings of a widely different nature.

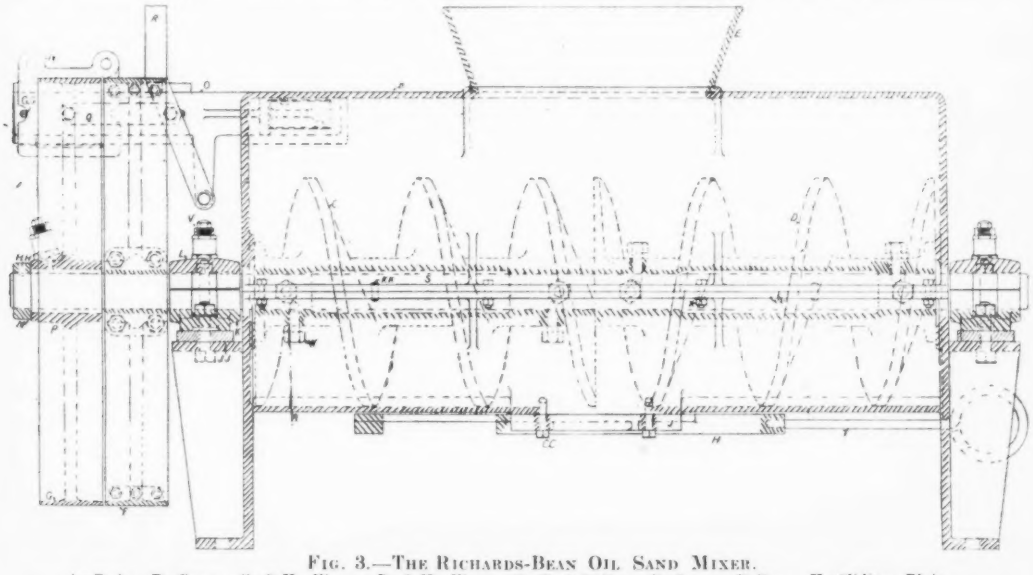


FIG. 3.—THE RICHARDS-BEAN OIL SAND MIXER.

A=Body; B=Cover; C=R.H. Worm; D=L.H. Worm; F=Fast Pulley; G=Loose Pulley; H=Sliding Plate; T=Pull-rod for H.

"Moulders" of the Industry.

No. 1.—MR. H. J. YOUNG.

Mr. Young, whose photograph we give below, is one of the best-known foundrymen on Tyneside. He was educated at King's College, London, and became associated with the Muntz Metal Company. Later he joined the late Professor Huntingdon, who had a very large metallurgical consulting practice. His first connection with iron-foundry practice was when he joined his present

Mr. H. J. Young.

firm, Messrs. The North-Eastern Marine Engineering Company, of Wallsend and Sunderland, as chief chemist. He has done much to instil chemistry and its value into the minds of foundrymen. He takes great interest in foundry apprenticeship training, and was one of the originators of the Junior Section of the Newcastle Branch of the Institute of British Foundrymen. This Branch last September elected him their president. He has contributed largely to the literature of foundry work, and for his Paper on the Problem of Grey Iron Castings he recently received from the Institute of Marine Engineers a special medal.

Iron Ore Exports from Sweden.—Exports of iron ore from Sweden during the first quarter of 1923 totalled 1,202,000 tons compared with 660,000 tons for the quarter in 1922.

Swedish Iron and Steel Industry.—Most of the Swedish iron and steel works have orders in hand for some three months ahead. Works not involved in the lock-out have only sufficient orders to keep their mills running. Buyers are disinclined to enter into contracts, owing to the uncertain situation in the labour market. Production during the first quarter of 1923 (compared with the same period of 1922, in brackets) was as follows, in metric tons:—Pig-iron, 37,300 (57,400); Bessemer ingots, 1,200 (7,900); open-hearth ingots, 13,400 (41,500); crucible and electric ingots, 1,700 (2,900); puddled bars, etc., 5,100 (5,700); rolled and forged iron and steel, 20,800 (39,900).

Locomotives for South Australia.—The Chief Commissioner of Railways in South Australia has informed the Railways Standing Committee that, with a view to the purchase of more powerful locomotives, he has made inquiries within the Commonwealth and in Great Britain, America, and Canada, and that as soon as a decision is reached tenders will be called for heavier engines. The Commissioner also intends to eliminate gradually all 6- to 10-ton trucks on the railways and to substitute trucks with a minimum capacity of 60,000 lbs. He also advocates the use of mechanical appliances in the State to facilitate and cheapen track laying.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Separating Charges in the Cupola.

To the Editor of The Foundry Trade Journal.

Sir,—In your leader entitled "Proof Wanted" you raise a very important and debatable question, and I trust all foundrymen who have had any experience in this direction will not hesitate to publish their results.

I do not in the least wish to run counter to Dr. Moldenke, because he may probably be right. Nor do I pretend to a knowledge of the higher branches of our craft or the fine chemical analysis of cast iron. Neither do I know anything of the possibility of the contamination by any of the constituents of one class of mixture of metal with another, when they are melted in a cupola at one blow.

Yet I do say that various mixtures of cast iron have, and can be successfully melted in the cupola. In my own experience as many as three distinct qualities have been run at one blast, *i.e.*, mixtures for turbine castings, motor cylinders and furnace fittings, including fire bars, and this without any extra coke to separate the charges.

The turbine casting mixture was put in first, the motor cylinder metal next, and the common last.

The ordinary amount of care is necessary to determine the quantity of metal put on, and the quantity taken out, if 20 tons of turbine mixture is put on surely it is not very difficult to know when that 20 tons is tapped out and so on.

In all of the above materials the test bars and the castings were quite satisfactory, so what does it matter if some of the constituents of one mixture get mixed with the other, so long as the ultimate result is satisfactory and passes all the tests and specifications, why all the enormous expense and trouble in having a separate cupola for each mixture, for this is what this matter is leading to, and even then I doubt if any foundry would undertaken work the specification of which calls for a definite chemical analysis in the casting. This would prohibit many foundries taking work of a different quality. I am thinking there are many foundries to-day taking and executing orders very successfully, for work demanding totally different mixtures of metal, and carrying them through with one cupola.

But all the same the subject matter is very fascinating, and if taken up by earnest foundrymen some startling findings will be given to us.—Yours faithfully,

An Old Furnaceman.

[Whilst "An Old Furnaceman's" contribution is very interesting and practical, he misses the main point entirely. Obviously, if 20 tons of low-phosphorous iron was contaminated with 10 cwt. of high phosphorous iron, no practical difference would be noticed, but if a ton of good iron was contaminated with a ton of bad, then the subject becomes of the highest importance. We are still awaiting proof that the cupola is capable of melting one charge, which can be tapped before the superimposed charge has started to melt or to exude its low-melting point constituents.—Ed.]

Catalogues Received.

Cast-Iron Pipes.—We have received from the Staveley Coal and Iron Company Limited, Chesterfield, their monthly stock list of cast-iron pipes for May.

Foundry Plant.—A leaflet is to hand from the Constructional Engineering Company, Limited, of Charles Henry Street, Birmingham, outlining a list of surplus stock. A second leaflet describes their cupolettes.

Pig-Iron.—From Messrs. British Pig Irons, Limited, of Abbey House, 2, Victoria Street, London, S.W.1, we have received a handsome book describing the manufactures of the Midland Coal, Coke and Iron Company, Limited, and outlining the service they give. The method adopted for the selection and grading of pig-iron is detailed.

Institution of British Foundrymen.

LONDON BRANCH.

At a meeting of the Branch held at the Institute of Marine Engineers, Minories, London, on Saturday, March 17, 1923, the Branch-President, Mr. Wesley Lambert, in the chair, a discussion was introduced upon "Grey Cast Iron and Grey Iron Castings," by Mr. A. E. McRae Smith and Mr. M. Benbow. These have already appeared in our columns.* The meeting was thrown open for a general discussion, which was initiated by MR. H. G. SOMMERFIELD, who said, in reference to Mr. Smith's remarks, that in a Continental works making heavy chilled castings, particularly stone crusher jaws and brick-making machinery, it had been found after many experiments that the best manganese-sulphur balance to work to was a relation of 3½.

With regard to the addition of aluminium and titanium to the ladle, he enquired as to percentages used and whether any appreciable loss of heat would be entailed due to stirring.

He was interested in opinions as to the effect of phosphorus, and recalled occasions on which metals containing above 1 per cent. phosphorus, when other elements remained the same, had shown evidence of distinct hardening, rightly or wrongly attributable to phosphorus.

Aluminium in Cast Iron.

MR. G. C. PIERCE, referring to the addition of aluminium, said he had used it as a deoxidiser, and he was of the opinion that, added to an iron, caused it to run very sluggishly, if the percentage of aluminium went beyond a certain figure. Very very little was required, certainly not more than 0.05 per cent. Dealing with Mr. Benbow's query as to feeding, he said that, in his experience, in one district managers required a job fed in one way and in another another way, and if anyone could lay down a definite rule as to how a job should be fed he would earn the thanks of everyone in the iron-foundry industry. He was of the opinion, however, that it would be impossible to lay down a hard and fast rule, because the feeding depended on the mixture of the iron and the nature of the casting. In some cases it would be found best to reach well to the bottom of the job, so far as practicable, with the feeding rod, whilst in others the feeding rod was dispensed with, so that if Mr. Benbow wanted a hard and fast rule laid down, he was seeking something which he would not get.

Feeding of Castings.

MR. J. J. MCLELLAND, after congratulating the authors on their Papers, said that Mr. Smith's Paper had been extremely interesting, and it would be very handy for reference purposes. Dealing with Mr. Benbow's Paper, he said that he had spent pretty well all his life in the foundry, and in different parts of the world, and consequently he had had opportunities which did not befall many of those engaged in foundry work. Mr. Benbow's Paper had raised a point which he himself had dealt with on previous occasions, namely, that in different localities foundrymen had different problems to deal with. With regard to methods of feeding, for instance, he was of the opinion that they might as well do without a feeding rod if the rod did not get right into the casting. He had been in the United States for a number of years, where he had had a marvellous experience which he had not been able to repeat anywhere else. He had had charge of a foundry in Bridgeport, Connecticut, for two years, where a brand of iron was used known as Virginia No. 2, and this was mixed with about 60 per cent. of scrap. On one occasion they made a lathe bed some 32 ft. long for the San Francisco shipyard, and, so far as he could gather, the makers of the lathe were quite satisfied with the quality of the material. During the whole time he was at that foundry he had never found it necessary to put a feeding rod in a casting; the iron seemed to be ideal from a practical point of view. In this country he was never more astounded than when he had first visited Falkirk, a good many years ago. He had visited a foundry where nothing but light work was being turned out. Scotch pig iron was being made at the works of the Carron Company, which were quite near, but he was astonished to find that, in spite of that, the people at the foundry he had visited were having Middlesbrough iron sent to them for practically all their work. He had found since that, for the class of work being turned out, such as fittings for stoves, gas-fire castings, bath tubs, etc., Middlesbrough iron was much more suitable, because it was more fluid in a molten state, and did not warp so much; also it did not fracture so easily when the castings were got out of the sand during the trimming process.

Hematite and Shrinkage Problems.

He (Mr. McLelland) then referred to another experience he had had during the war. A foundry manager, without practical experience, was in charge of a foundry where they were making shells. The firm had never done work of this kind before, which had to be made to a definite formula. The formula, he gathered, specified the percentages of the various elements that went to make up a mixture of cast iron, and he believed that the brand of iron to be used was specified. His friend, however, had tried many different methods of making shells, but had not met with success. He had consulted Mr. McLelland, who had found that the chief trouble seemed to be connected with shrinkage and with feeding. They cast in different ways; sometimes the shells were cast bottom upwards, with a large head equal to the full diameter of the shell, but when they cut the shell off they found a great spongy place at the base of it. They then tried casting with the bottom downwards, without risers, and with the core hanging, but the results were similar, there being more or less a gap at the bottom of the shell just beneath the core. His friend had to adhere to the Government's formula, because test bars were cast so that they knew exactly what he was using. He (Mr. McLelland) had suggested to his friend that he should keep to the Government analysis, but, without saying anything about it, should add about 5 per cent. of hematite to the mixture, and should not exceed that figure. A week later his friend had told him that he had been successful; the shells were all right, and there was no further trouble. He mentioned that to show that circumstances influenced foundrymen from a practical point of view more than anything else. In the South of England competition made it necessary that they should buy in the cheapest market in order to get trade, and consequently they got some of the more inferior makes of iron, but in the North of England they could get better qualities possible at a lower price.

More about Aluminium.

MR. J. B. STONE (Grantham) disagreed with Mr. Pierce's remark that the addition of aluminium to the ladle resulted in the metal running sluggishly. If the aluminium were cold when it was added, then the metal would become sluggish, but if it were added hot, then a high percentage could be added and the metal would still run easily. Another addition that would help was ferro-manganese, and this would partly control the sulphur also. With regard to ferro-aluminium, he had used it some 20 years ago, in malleable iron particularly. He always kept a certain amount of aluminium for use when he had a sluggish melt, and he had always found that it helped him considerably. With regard to core oils, five or six years ago he had made the same statement as Mr. Benbow as to linseed oil, and he proved it to be successful at that time. Dealing with risers, his experience was that the use of these depended on the men feeding the castings.

THE BRANCH-PRESIDENT asked Mr. Stone what quantity of aluminium he had used.

MR. STONE replied that the quantity used for a shank of metal was a piece about the size of a walnut; he could not give the exact weight, because he did not trouble to weigh it. The capacity

* See issues of March 29 and April 3 of THE JOURNAL.

of the shank was about 1½ cwt. To steel he added, in the crucible, about 1½ oz. of aluminium.

Aluminium and Fluidity.

Mr. A. R. Bartlett said he had used aluminium in the pure stick form in order to make the metal more fluid. The method was to throw a little piece into the ladle before tapping was commenced, the proportion being 1 oz. to a ton. That might appear to be rather a small quantity, but he had found it most useful. It did no harm, but it kept the metal fluid, and it was possible to keep it hot for a longer period. With regard to the use of heads, Mr. Benbow had asked whether these were serviceable on castings or not. Personally, he liked them on castings that had to stand pressure, and the more head the better. As to feeding, he contended, as a rule, that feeding with a feeding rod should be avoided whenever possible. The method of feeding that he believed in was to put pressure on a casting, and, in the thick sections, to use chills or denserers. When feeding a casting with varying sections one could not possibly make the feeding rod reach the sections requiring it. The upper sections might be thin as compared with the heavier sections lower down, and the rod could not reach the heavier sections, because those at the top became set before the thicker sections lower down. With regard to core oils and core sands, sea sands were an impossibility, because they cost so much that they were prohibitive. He himself used Leighton Buzzard sand as a sharp sand, but only as an opening product in connection with washed inland sand. Invariably he found that the best oil was single-boiled linseed.

Inherent Properties Raised.

Mr. E. H. Brown asked Mr. Smith whether he honestly believed that there was any actual difference between two irons of identical composition made in different districts; in other words, whether any one particular brand of iron possessed what were generally known as inherent properties. Mr. Benbow had asked some questions with regard to cylinders. Some two years ago he (Mr. Brown) had visited one of the biggest works in Amsterdam, where they were making cylinders. In almost every cylinder, whether for marine or locomotive work, the usual practice was to run a head, about 3 in. wide at the top and 1½ in. wide at the bottom, on the top flange, about 2 in. deep. He took that as being the regular practice of a firm specialising in this work. The composition of the metal was what might be ordinarily expected in this class of work, except that it was somewhat higher in sulphur.

With regard to dry sand castings, in the North of England, where considerably more work was bedded into the floor than in this district, it was the invariable practice of the moulder to vent round a joint in the way suggested by Mr. Benbow, not only to prevent scabbing, but also to give freedom from what practically amounted to the same thing, namely, the lifting of the blacking. Dealing with the running of a cupola, where it was exposed to the weather he had found that, in order to get regular and consistent running, it was useful to close the tuyeres for five or ten minutes before charging and blow up the bed with two special tuyeres right at the bottom of the cupola in order to blow the bed white hot before laying in the first charge of metal. The varying moisture coming into the blast would also affect the running of the cupola, and, by a slight variation of the volume of the blast entering, one could usually get the correct temperature, provided that the question were studied sufficiently to give one some idea of the variation under particular conditions.

Cylinder Heads.

Mr. C. A. Otto, dealing with Mr. Benbow's Paper, said he was particularly interested in that part of it which dealt with heads on cylinders. In some parts of the country, particularly in connection with marine work, cylinders were cast with the crown upwards, and in that case heads could not be used with advantage, but such cylinders were undoubtedly cast successfully. Some time previously he had been speaking to a moulder who had been casting cylinders for a long period, and who had not had a bad casting for 18 years, the majority of which were cast crown upwards. Special cylinders, which had to stand a very high pressure, were usually cast with the crown downwards, and with a head. Mr. Benbow had spoken of a head 8 in. high and 4½ in. thick, graduating down to 2 in. or 2½ in., *i.e.*, from the flange at the open end of the cylinder. Such a large volume of metal carried in the form of a head had a certain influence on the end of the casting after it had cooled down, which was such that, when it was cut off and a rough cut taken from the inside of the cylinder, some considerable time was allowed to elapse before the finishing cut was taken. This was due to the unequal contraction which strained the casting, and a slight readjustment takes place which partly releases the strain after the head has been removed. It had frequently occurred to him that such substantial heads might well be cut by cores in four or six places instead of making them continuous, in order to remove, to a certain extent, the cause of the strain, while still retaining the head, and so avoid the time of waiting before the final cut could be taken. With regard to the pouring of these castings, for many years it had been the practice in one large foundry with which he was connected to pour from the top, the idea being to keep hot metal at the top and to keep it agitated during the time the mould was being filled. This prevented a skin being formed on top of the metal, which collected dirt, and which was likely to be trapped at any point while the metal was rising. On the other hand, changes in pouring were made at various times, and bottom pouring was used in some instances, but the mould was not wholly filled by bottom pouring; a certain amount of metal was allowed to enter by way of the steam chest flange, and, after a quantity had been introduced in this way, top pouring was commenced. Where top pouring or bottom and top pouring was used the castings were usually good.

Pencil Runners.

Mr. G. Hall said that he also would take great care of Mr. Smith's Paper; indeed, they would all, as foundrymen, do well to take care of it, because they would find it very useful in the future when in trouble. With regard to the use of aluminium, he had found it very useful if used in the proper quantity, and had obtained good results, but the quantity used must be small. In a 2-cwt. ladle he generally used a piece of aluminium less than half-an-inch square, and did not specify any particular weight—aluminium was roughly one-third the weight of iron or gunmetal. Nobody had dealt with the question raised by Mr. Benbow with regard to the use of pencil runners on top of castings. These, to his mind, were allied to the question of risers. He believed he was one of the first in England who had experimented with these pencil runners after M. Ronceray had written about them in the "Fonderie Moderne," and he had had some very miserable failures, and after M. Ronceray had lectured to the members of the London Branch of the Institution he had experimented further. As a result, he had come to the conclusion that the more they experimented the more they would eliminate risers on castings. He had not experimented with large castings, because he had not dared to run the risk, but he assured the members that on small castings they could do away with risers by putting a small pencil runner on the top. He had tried some castings with very small runners at the bottom, but they were wasters, but, by putting a very small runner on the top, and using very hot metal, good results could be obtained.

Use and Abuse of Aluminium.

Mr. V. C. Faulkner (Hon. Secretary), dealing with aluminium, said it was certainly very useful as a deoxidiser, but must only be used in small quantities, because when the metal was heated the aluminium formed a white powder (alumina), which remained between the grains and made for weakness. In steel one was very careful to keep the quantity one used down to a minimum. He had understood Mr. Smith to say that he had used ferro-aluminium, but did not think he had given any reason for that practice: also, he was talking of ferro-titanium at the same time. These alloys varied: many foundrymen receiving an alloy were informed that it was ferro-titanium, and that was all that it meant to him: but they

had to be most careful in choosing such material. When Mr. Melmoth had lectured to the Branch at the beginning of the session, the question of ferro-titanium in steel had been discussed,* and he believed they had come to the conclusion that if they used high-carbon ferro-titanium in steel castings it gave hard spots, but with low carbon it was very successful. With reference to Mr. McLelland's remarks, Middlesbrough pig-iron was still used in Scotland for the light castings trade, and he did not think they could use Scotch iron for it, as a high phosphorus content was essential.

MR. STONE (Grantham), dealing with liners for oil engines, said that he made them with a runner at the bottom and a head on the top. The head would be 4, 6, 8, or 10 in., depending on the size of the liner, and he got very good tests from them.

Cement in Core-making.

MR. J. W. GARDOM said he had used aluminium and it certainly did not make the iron chill. He believed that different people were getting different results, due, probably, more to the melting practice than to the actual addition of aluminium. Mr. Smith had gone into the problem of the action of the elements upon grey iron, but when they came to consider the interaction of one element, and the number of different alloys that could be made out of five elements, it was almost impossible to conceive what could happen as the result of the presence of one element in actual practice. He had certainly not found that the aluminium had the effect of chilling the iron, but he believed that that might be brought about more or less by the melting practice, and probably by the presence of large amounts of oxygen in the iron. With regard to core oils, he had been making up cores by the addition of cement to sand, and had obtained quite good results; he was only dealing with extremely small cores. He had some that had stood up six months and had been satisfactory. They were simply air dried; no wires had been put in them, whereas this had been necessary with linseed oil. When he first started to make these cores he had made a mistake and had used lime instead of cement, but, nevertheless, he had obtained good results. Such cores would not last long, but they dried extremely well.

MR. STONE (Grantham) said he had tried the addition of cement to sand for cores, but, as a commercial proposition, he did not believe it would do. If they had to do a job quickly and had to wait 24 hours, or at least 12, for the core to dry it was out of the question.

Influence of Aluminium Summarised.

THE BRANCH-PRESIDENT expressed his appreciation of the value of Mr. Smith's Paper, especially for reference purposes. Dealing with the addition of aluminium to iron, he asked speakers to be careful to state the amount of aluminium they added. He had been up to Newcastle recently, and he had found there that, instead of adding ½ oz. to a shank, experiments had been carried out with cast iron to which 5, 10, 15, 20 and 25 per cent. of aluminium had been added. That was on a totally different scale from that which had been discussed that afternoon, the idea being to make an alloy which would be resistant to scaling effects at high temperatures. In one case 15 per cent. of aluminium added to cast iron gave an alloy which was very successful from this point of view. It was heated up for 30 separate hours, *i.e.*, it was heated for an hour to 1,000 deg. C., allowed to cool, and then heated again, in order to make the test as drastic as possible; after 30 hours the surface of the metal was as bright as when it was machined, there being hardly a tarnish on it. He mentioned this because at a former meeting a Paper had been read on malleable iron and the boxes used in this connection. He had mentioned to Mr. Faulkner after that meeting that he thought something was being done to increase the life of the boxes used in the malleable-iron industry. He had in mind a process known as the calorising process, which consisted of embedding cast iron in powdered aluminium and heating it up to a very high temperature, until a certain quantity of the aluminium had migrated into the surface or became oxidised, forming aluminium oxide, which was very resistant to high temperature. At any rate, the calorising process was used in quite a number of small details, one of which was in connection with all burners for locomotive fire boxes, where it was necessary for the steam to be highly superheated, for the purpose of the atomisation of the oil, and it was passed through a tube, which, however, would not stand up to the work for any length of time. The so-called calorising process was adopted, and the tubes had considerable life. It was found not even necessary to embed the cast iron in the aluminium powder. It had been proved that, by spraying aluminium, *i.e.*, metallic aluminium, on to the surface of cast iron and then subjecting it to the heat that the metal had to stand up to, that in itself would form a very protective coating, and fire bars, superheater tubes, and quite a number of things were actually being treated.

Need for Research.

Reverting to his remarks as to the large quantities of aluminium which were added to cast iron in the Newcastle area, he had not thought, when he had seen the specimens, to ask whether the iron ran sluggishly. The plates he had seen certainly appeared to be quite good, but perhaps if aluminium were added in larger quantities the product might have very different properties. Mr. Gardom had mentioned that a large variety of irons could be obtained with the variation of the elements in cast iron. Mr. Young, of the North-Eastern Marine, had been telling him (the Branch-President) that, in conversation with a foundry manager, he had asked him whether he was contributing to the Cast Iron Research Association. The foundry manager had replied that he was not, and that he could not see why he should: he had said that we knew all about cast iron, and did not see any necessity for research; he never had wasters in his foundry, neither had his father, who was manager before him. All that he (the Branch-President) could say in regard to that was that, as a metallurgist, and as one who had been connected with cast iron for some 20 years, he still found that there was an enormous number of problems coming along for investigation, and he welcomed the Cast Iron Research Association and its work. If any of the members saw the results of some of the investigations they would recognise that there was quite a number of problems for examination, more particularly associated, perhaps, with specialities. Cast iron was used for such a number of specialised castings that he could not see how they were to answer Mr. Benbow's questions as to whether feeding heads were the correct things to use.

The Author's Reply.

MR. MCRAE SMITH, in reply to the discussion, offered an apology to the metallurgists present at the meeting. His Paper was merely a summary, very loosely put together, and he did not mean to enter into any metallurgical controversies. He certainly agreed that, theoretically, and in very many cases practically, a very small percentage of aluminium, probably in the neighbourhood of 0.02 or 0.05 per cent., gave greatly increased fluidity. What he had explained was that in the sometimes rough-and-ready methods of the foundry, where perhaps a large quantity was put in, and where sometimes they were dealing with a cwt. shank and sometimes a 5-ton ladle, rather uncertain results were obtained. The particular instance of which he was thinking was that of iron which was being used for pressure work, standing about 500 lbs. air pressure. In that case aluminium sometimes gave success, but sometimes it did not, there being very small pin-hole leaks. Dealing with Mr. McLelland's remark that Middlesbrough iron was used at Falkirk for light castings, he believed that could be attributed to composition, because Scotch iron was comparatively low in phosphorus and not suitable for the very light work made there. He had been asked whether two pig-irons, of exactly the same composition, from two different districts, exhibited any inherent property which made a difference when the irons were re-melted. That brought up the old query

* "Notes on the Development of the Manufacture of Steel Castings," by F. A. Melmoth, published in THE FOUNDRY TRADE JOURNAL for November 2, 1922, p. 355. Discussion published in THE FOUNDRY TRADE JOURNAL for November 30, 1922, p. 444.

as to hot- *versus* cold-blast pig iron, involving a discussion upon net-work structure and other factors, so that he thought it best to leave that alone. With regard to feeding heads, his experience was that if they were to put heads on castings they must be sufficiently large and of the right shape for feeding; but he had found very often that heads were put on which were totally inadequate; in such case they would be far better without them.

A point had been raised about the warping of cylinders which had been cast with a head, and he had experienced that. In this case the head was cut off, the bore was rough cut to see if it was all right, and it was found to be perfectly sound. For some reason the job was postponed, and the cylinder was laid aside for about 18 months, after which it was found to have warped very considerably.

Mr. Benbow, who had nothing to answer, expressed his thanks to the members who had discussed the Paper and had answered some of the questions which he had asked. The discussion had been very beneficial to him.

Mr. McLelland expressed the thanks of the meeting to the authors for their Papers, and for the time spent and the trouble taken to prepare them.

Mr. Shillito seconded and expressed the hope that the practice of holding meetings on Saturday afternoons would continue. He hoped the Branch would have other Papers from the two authors in the future, and suggested that the Papers read that afternoon were worth translating into French.

The vote of thanks was accorded with acclamation.

LANCASHIRE BRANCH.

Burnley Section.

At a meeting held on Thursday, April 5, at the Technical College, Burnley, Mr. J. Hogg in the chair, Mr. S. Langton (Stockport) read a Paper upon "Practice and Problems in a Non-ferrous Foundry." This was largely a repetition of a Paper entitled, "Casting of Brass and Aluminium," which the author gave before the Lancashire Branch in 1921.*

Discussion.

Mr. Pell said in his opinion in casting a 5-cwt. wheel in brass or gunmetal, a ¾ in. runner was not sufficient.

Mr. Langton: For a 5-cwt. wheel we would cast down two gates, and two heads.

Mr. Pell: Then one being insufficient, two are put on?

Mr. Langton: Yes, but for a 3-cwt. wheel perhaps two would not be necessary. Brass or gunmetal must not be cast too hot.

Mr. Pell asked whether the author had any experience of the melting of aluminium swarf and brass swarf. In melting L5 Air Board specification metal he found that a scum formed on the top of the pot, and it had to be cleared off before they began to cast in the moulds. He had tried to recover the aluminium from that scum by throwing it on the fire at night and collecting the next morning the aluminium which had run through to the bottom. That might be a poor method, and he would be much obliged if Mr. Langton would indicate a better one, and also explain generally how he dealt with brass swarf and gunmetal swarf.

Mr. Langton said he had but little experience of aluminium swarf. In any case there would be a considerable loss. The only method he could suggest was to clean it as well as possible, remove the dust, and flux it with sal ammoniac during melting. That would bring all the dirt to the top. Brass swarf is easily dealt with if you have any quantity. It is magnetically separated from iron, then melted down and poured into ingots.

Mr. Pell asked whether when the aluminium was charged charcoal or similar material was put on the top of it? He asked that question because it had been said that if the aluminium was not covered it was subject to oxidation.

Mr. Langton replied that he did not think the metal was affected by charcoal, unless overheated.

* See Institution of British Foundrymen's "Proceedings," 1920-1911, page 352.

Square or Round Furnaces.

Mr. Hartley asked if the author were building a new tilting furnace, would he choose a round or square one?

Mr. Langton said the one he used was square. Mr. Pell had shown him a round one, but he did not think there was sufficient difference between the two types that it was worth while to change from one to the other.

Mr. Pell said he was advised to put in a round furnace because he could have an equal fire all the way round, whilst in the square furnace, with four corners, more coke would be required. Therefore the former was more economical.

Mr. Hartley pointed out that in the square furnace it was more easy to knock the coke away from the corners where it was loose. In the round type the distance was the same all round.

Mr. Barnes asked whether there was any difference between melting in the crucible and in a cast-iron shank?

Mr. Langton: Yes, because aluminium attacks iron very rapidly. Anybody using an iron poker to stir aluminium will find that out very quickly, and a wooden rod is preferable.

The Chairman said he had a preference for gating on the top. Mr. Langton in many instances used densers. These were very useful in their place whether in casting iron or non-ferrous metals. In remelting aluminium was it necessary to add some new metal in order to get a good casting? He understood that one could not go on using scrap over and over again as one could use iron.

Mr. Langton: There is a limit to it certainly. Providing it has not been burnt, it is thought that the metal is not affected to any great extent, and one can use the scrap two or three times, but there is obviously a limit to it.

Inferiority of Remelted Metal.

The Chairman added that he used a considerable quantity of remelted aluminium for making certain castings, and this metal never gave the same results with the second melting as with the first. The castings were not as nice, nor had they as good a finish as when cast direct from the ingot. Possibly the melting practice was imperfect. Another important factor he had noticed was that after aluminium patterns had been in the store-room for some time, they became spongy and full of holes. The metal seemed to crumble away at the corners.

Mr. Langton agreed that aluminium was affected in that way, due to the formation of an oxide. He had been told that to some extent the oxide was a protection, and should not be wiped off. Was this on the plate or on the pattern?

The Chairman: It is on the pattern as well.

Mr. Langton said it agreed with his experience. It seemed to go just at the sharp corners.

The Chairman stated that a number of brass plates were moulded on the flat and cast on the end at different temperatures, and whilst the lower part was perfect, the tops were imperfect, due to blow-holes. If his recollection was correct the mixture was 85 per cent. copper and 5 per cent. tin.

Mr. Hartley said he had cast similar plates about 20 in. by 12 in. and 1½ in. thick, in a cast-iron chills, and they were satisfactory.

"Atmos" Boiler for High Steam Pressures.—A Swedish engineer, Mr. Viktor Blomqvist, of Stockholm, has recently patented a high-pressure boiler, the "Atmos." The chief characteristic of this design is that steam is generated in rotating elements which are fed with boiling water from a stationary heater. The elements are composed of tube systems rotating at great speed on a shaft, which has the effect of keeping the inner tube casing continuously covered with boiling water unmixed with steam—as the force of the water pressing against the casing will prevent steam bubbles from collecting on its surface—whereby the tube is always effectually protected. The design of the Atmos boiler makes it possible to generate steam at a pressure of up to 150 atm. (say 2,200 lbs. to the sq. in.), or even more, without injury to the rotating tube system. When steam is required for power-generating purposes a saving in fuel of 20 per cent. is claimed with the Atmos boiler. The boiler is also much lighter, and takes up less space than an ordinary boiler of similar capacity.

Comparison of Sand-Cast and Machine-Cast Pig-Iron.*

By S. B. Phelps, M.A.

There has been considerable difference of opinion on the relative merits of chilled pig-iron and sand pig ever since the introduction of the machine casting method about 25 years ago. The chilled pig-iron has constantly increased in favour among foundrymen in spite of the inability to mix or judge its quality by fracture. The writer believes that this is the most practical point of favour of the sand-cast pig to-day, though the value of this characteristic lies chiefly in enabling the foundryman to identify such irons by fracture without waiting for a check analysis when the yard labourers lose or misplace the analysis markings on the piles of pig.

More Research Needed on Irons.

Foundrymen are usually placed at a disadvantage in trying new products because they are seldom given sufficient facts on which to base their decisions. This applies not only to a lack of research on pig-irons even to-day, but to all phases of foundry practice and to all materials. The critical machinist might be surprised to learn that, if every foundryman knew all facts discovered by foundrymen and scientists, they would not be sufficient to enable him to produce perfect castings continually. The foundrymen's resourcefulness must still be relied upon to overcome the difficulties which science has not yet explained.

Economic Effects.

Consideration for the general prosperity of the foundries and allied industries as well as national emergencies make it important for foundrymen to investigate and compare the merits of both types of pig-iron regardless of any natural preference for either type.

During the war it was frequently impossible for American foundrymen to obtain pig-iron of proper analysis for their mixtures and reputations for castings of quality were injured, regardless of this cause, for foreign buyers especially never know such details. Inability to obtain sufficient pig-iron of the desired analysis when a shortage exists, or when transportation is restricted, certainly should not be further complicated by insisting on securing iron cast by cone method regardless of the freight haul.

Casting Sand Pigs from Chilled Pigs.

The reduction of the grain size by the chilled moulds is no handicap to-day, as almost all mixes are made or regulated by analysis, but, should the foundryman wish to know the fracture of chilled pig-iron, he can easily determine it by making special charges of the pig at the beginning of the heat and simply pouring it into sand pig moulds. In testing new brands, the writer frequently used a shrinkage test-piece with a cross section approximately equal to a pig. A sand pig cast from chilled pigs would have a closer grain due to the oxidation of about 0.25 per cent. of silicon and a gain in sulphur. The result, however, would be practically the same as if sand-cast pig had been tested. The foundryman must discount these changes made by the cupola when mixing by fracture, so that is no objection to such a test.

Melting and Spout Temperatures of Sand and Chilled Pigs.

The fact that sand-cast pig cools slowly and causes most of the carbon to separate as graphite, whereas chilled pig retains the carbon in the form of combined carbon(Fe_3C), is of interest, because the melting point is influenced by the amount in the combined form as well as the total carbon. According to Wüst and Peterson, the freezing points range from 1,155 deg. C. for an iron of 0.75 per cent. silicon and 4.02 total carbon to 1,205 deg. C. for an iron of 4.00 per cent. silicon and 3.24 total carbon. This gives a range in the melting point due to the total carbon in foundry brands of about 55 deg. C. Dr. Moldenke, in his excellent book, "The Principles of Iron Founding," gives 1,085 deg. C. as a minimum melting point for white irons and 1,245 deg. C. as a maximum melting point for grey iron varieties, or a difference of 160 deg. C. for the 63 specimens tested in his investigation, to prove that combined carbon lowered the melting point of iron.

Machine-cast pig undoubtedly melts at a lower temperature than sand-cast pig of similar analysis, and probably regardless of the analysis for foundry grades. This fact, together with some observations of molten iron, has caused some foundrymen and metallurgists to believe that machine-cast pig produces hotter iron.

It seems that almost anything can be proved from a cupola. Cupola practice varies widely, because of the practical necessity of foundries being required to use scrap of more or less irregular size and analysis, together with the variations of the volume of air blast. The operation of cupolas by labourers, to a large extent, does not tend to produce uniform results. Even under ideal, practical conditions, the cupola does not permit scientific results of laboratory exactness. The writer has at times observed by eye considerable changes in temperature during the heat, and has noted variations of about 50 deg. C. with an optical pyrometer after the lining had become heated and before there had been any chance for slag to interfere with the blast and otherwise conditions were practically uniform. This condition probably is caused by temporary interference with the blast by the charges.

Some consider that sand-cast pig produces hotter iron because it absorbs more heat before it melts, due to its higher melting temperature. Sand-cast pig must, of course, absorb more heat than chilled-cast pig, but in doing this it sinks lower in the cupola than chilled cast pig. The molten drops of chilled pig therefore fall a greater distance through the hottest region of the cupola than the sand-cast pig, with the result that the radiation from the incandescent coke has a longer time to superheat the molten drops from the chilled pig. As the transfer of heat by radiation is much more effective than by conduction, the advantage should be in favour of the chilled pig, especially as the total drops melted from a pig present a greater surface to radiation than the surface of a solid pig. The writer believes that, whether the two conditions mentioned just balance or not, there is no practical difference in the cupola spout temperatures of sand-cast or chilled pig with similar total carbon content.

It is not to be expected, however, that a mixture of both kinds of pigs in the same charge will give such uniform results as a mix made from one type of pig. For conditions, not very exacting, the loss of chilled pig in each charge, after the first one, is compensated somewhat by the addition of molten iron from the chilled pig in the following charge. A mixing ladle, forehearth, or a reasonable quantity of molten metal held in the cupola before tapping also assists in giving more uniform iron when one type of pig cannot be used exclusively in the mixtures.

Undoubtedly, chilled pig is to be preferred to sand-cast pig if it were only to avoid the excess slag produced by the sand clinging to the pigs. The sand increases the danger of slag inclusions, causes considerable difficulty in long heats in its removal from the cupola, interferes with the blast and therefore tends to cause uneven melting and dull iron. The resulting defects and losses in castings not only affect the foundry, but also the machine shop.

* From the "Blast Furnace and Steel Plant."

A New Synthetic Moulding Sand.

Messrs. The General Refractories Company, Limited, of Kelham Island, have placed upon the market a new sand, which they have called York Yellow.

Mr. O. E. Druce has retired from Miles, Druce and Company, iron merchants, Trig Wharf, Upper Thames Street, London, E.C.

Mr. H. G. Jackson, a director and secretary of the Judson-Jackson Company, Limited, machine tool merchants, of 50, Marsham Street, Westminster, London, S.W.1, is taking up residence shortly in New Zealand, in which country he will act as the firm's representative. Mr. P. J. Colverson has been appointed secretary in his stead

Trade Talk.

MR. H. DOREY, of Finchley, has acquired the Soho Metal Works, 12, Hanway Street, London, W.1.

ASCOG, LIMITED, iron, steel and machinery merchants, have removed to 13, Sackville Street, London, W.1.

O. T. LEMPRIERE & COMPANY, Australian tin, ore and metal exporters, are erecting smelting furnaces on a site near Sydney.

PALMERS SHIPBUILDING & IRON COMPANY, LIMITED, who recently restarted two furnaces on hematite, are preparing to restart a third furnace.

S. DIXON & SON, LIMITED, brassfounders, of Swinegate, Leeds, have removed their London office from Kingsway House, Kingsway, W.C.2, to 100, Victoria Street, S.W.1.

TWO BLAST FURNACES were blown in at the Govan Ironworks of Wm. Dixon, Limited, in October last, and two others since. The results so far do not warrant the blowing in of more furnaces either at Govan or Calder.

LAWSON, WALTON & COMPANY, LIMITED, St. Nicholas Buildings, Newcastle-on-Tyne, are now acting as the northern representatives of E. Roper & Company, foundry engineers, Keighley, for their foundry melting equipment specialities, etc.

THE FIRE WHICH OCCURRED at the Templeborough works of the Sheffield Steel Products, Limited, resulted in heavy damage and the loss of the canteen and outbuildings which were erected, in 1916, to find accommodation and catering for the female employees.

LICENCES under the Non-Ferrous Metal Industry Act, 1918, have been granted to Alexander and Company, Limited, 44-46, Leadenhall Street, London, E.C.3; Lempriere, O. T., trading as O. T. Lempriere and Company, 1, Queen Victoria Street, London, E.C.4; Stewart and Sons, R. F., 39, Liverpool Street, Newcastle-on-Tyne.

THE AVERAGE PRICE of Siemens steel bars in South Wales has been ascertained by the auditors to be £7 7s. 7½d. per ton, and thus fails to reach the operating price of the sliding scale of wages in the tinplate trade—£7 10s. The employers, however, have, on the application of the men, extended their 7½ per cent. concession as from May 6 to August 4 next.

THE DIRECTORS of the Argentine Iron & Steel Company, Limited, referring to the announcement made at the general meeting held on December 29 last, to the effect that an arrangement had been made by which, in certain circumstances, Baldwins, Limited, and Sir William Arrol & Company, Limited, would acquire an interest in the company, state that they have been notified that the companies in question have decided not to proceed further with the proposal. With the concurrence of the board, Mr. Russell Kettle, of Messrs. Deloitte, Plender, Griffiths & Company, has been appointed by the Court as receiver and manager on the application of the trustees for the debenture-holders, this step having been taken to maintain matters in *statu quo* pending submission to the creditors and the shareholders of a scheme of reorganisation which is now under consideration.

Company News.

Vickers, Limited.—Ordinary dividend for year, 5 per cent.

XL Foundry, Limited, Foleshill Road, Coventry.—Capital £250 in £1 shares.

John Tearn, Limited, Leicester Street Foundry, Sheffield.—Capital £5,000 in £1 shares. Ironfounders.

John Baker & Company, Limited.—Loss for year, £17,501; brought forward, £12,945; debit to profit and loss account, £4,555.

All-Metals Company, Limited, 59 and 59A, Bayham Place, Camden Town, London N.W.—Capital £2,000. Director: W. H. Horsfield.

A. Deacon & Company, Limited, 97, Rea Street, Birmingham.—Capital £2,000 in £1 shares. Stamped and general brass founders, etc.

F. Reddaway & Company, Limited.—Dividends, 6 per cent., less tax, on ordinary and preference for year, appropriating £25,000 from reserve; carry forward, £12,039.

Provincial Sheet Metal Works, Limited, Gander Green Lane, Cheam, Surrey.—Capital £1,000. Directors: A. W. Cutler (chairman and managing director) and J. Bastable.

J. R. Young, Limited, 1, Post Office Buildings, Alnwick.—Capital £5,000 in £1 shares. Mechanical engineers, founders, etc. Directors: J. R. Young, W. Neilson, and F. Rowley. Secretary: F. Rowley.

James Dunlop & Company, Limited.—Loss on year's operations, £27,431; preference dividend paid for year, £19,500; total debit balance, £46,931; brought forward, £16,727; adverse balance, £30,204; transferred from reserve, £40,000; carry forward, £9,796.

William Dixon, Limited.—Net profit, £68,356; brought forward, £9,942; interim dividend on 5 per cent. cumulative preference, £7,500; annual payment to mortgage debenture stock trustees for redemption of stock, £15,000; dividend on 5 per cent. cumulative preference shares for half-year ending February 28, £7,500; dividend 5 per cent., free of tax, on ordinary, £32,800; carried forward, £15,498.

Gazette.

THE CHESTER BRASS & IRON FOUNDRY, LIMITED, is being wound up voluntarily, with Mr. W. Baird, of Chester, as liquidator.

THE shareholders of the Clegg Foundry Company, Limited, have decided to wind up the company voluntarily. Mr. S. Laycock, Barclays Bank Chambers, Keighley, has been appointed liquidator.

MESSRS. S. HATTON, S. Hatton, S. Hatton, senr., J. Hatton and H. A. Bore, ironfounders, Albion Road, West Bromwich, trading under the style of Hatton, Sons & Bore, have dissolved partnership. Mr. H. A. Bore will continue the business.

The House for Plumbago
and everything for the Foundries.
William Olsen, Ltd., HULL.

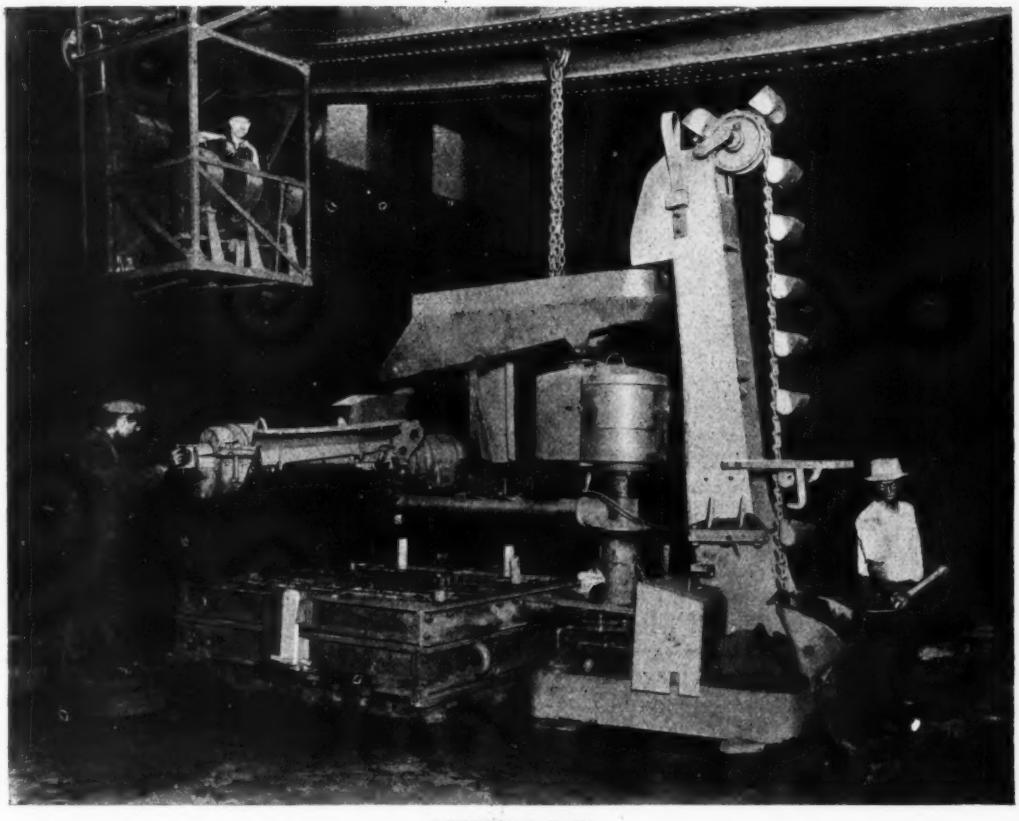
Alex. Findlay & Co.
Structural Engineers **LTD.**
Motherwell :: Scotland

STEEL BRIDGEWORK
BUILDINGS . ROOFS
GIRDERS . ETC.
Steel . Pithead . Frames
Steel Wagon Underframes

..... *Speciality*: .....
Stamped Steel Floor Troughing

Head Office: MOTHERWELL, N.B.
London Office: 9, VICTORIA STREET, S.W.
Telegrams: { FINDLAY MOTHERWELL. / PARANEUK, LONDON.
ABC CODE 4th & 5th Editions.

THE BEARDSLEY-PIPER SAND SLINGER MOULDING MACHINE



PORTABLE TYPE.

The above illustration represents the latest type of the Beardsley-Piper Sand Slinger Moulding Machine produced for the particular requirements of jobbing foundries.

This machine will ram 1,000 lbs. of sand per minute and can be applied to any type of moulding in a jobbing foundry. We have machines operating on moulds 30 feet long, while the same machine can conveniently be used for ramming a 24" box without alteration.

THE PORTABLE TYPE SAND SLINGER IS THE ONLY MACHINE CAPABLE OF PRODUCING MACHINE MOULDED CONDITIONS ON JOBBING CASTINGS.

The machine is lifted by an overhead crane and is placed alongside of a moulding box which has been prepared for ramming. The pattern can be rammed in to make a bed, the box turned over, a parting struck, the drag part of pattern placed in position, and the ramming of drag completed by the Sand Slinger. The bye sand is removed, new parting made, top part of pattern correctly placed, moulding box placed in position, hangers, runners, etc., located, and the Sand Slinger brought back to complete the ramming. In this respect ramming is done exactly as it would be done by hand labour.

TAKE THE MACHINE TO THE JOB IN ANY PART OF FOUNDRY ACCESSIBLE TO OVERHEAD CRANE.

Please note that the entire ramming is completed by the Sand Slinger unless where direct undercuts of considerable depth are included in the pattern. These can readily be tucked and the ramming proceeded with.

We have much data of interest to the practical foundryman. Demonstrations can be arranged to illustrate the principle of the machine by appointment. Write for Illustrated Booklet.

FOUNDRY PLANT & MACHINERY LIMITED,

28, Royal Exchange Square - - - GLASGOW.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The continued uncertainty of the political situation on the Continent, and decreased pressure of demand on home account, has had a retarding effect upon buying in the Cleveland iron market, and at the moment business is, comparatively speaking, idle. It must not, however, be overlooked that many of the large consumers of pig have bought forward on more favourable terms than those at present offering for some time ahead, and consequently makers, having an assured outlet for current outputs, express little inclination to increase commitments. On the other hand, consumers hesitate to extend purchases in the expectation of further weakening in values. So far, there has been no change in prices, quotations remaining at last week's levels as follows: No. 1, 130s.; No. 3, G.M.B., 125s.; No. 4 foundry, 120s.; No. 4 forge, 115s. to 117s. 6d. per ton.

The position in regard to East Coast hematite is very similar to that of foundry iron, particularly as the great bulk of the iron sold abroad this year has been hematite iron. With the re-starting of Messrs. Whitwell's Tees-side works during May there will be two more furnaces on hematite. Still, at Tuesday's market there was no disposition to weaken on the part of the makers, and while East Coast mixed numbers are obtainable at 122s. 6d., some sellers are holding out for 124s. per ton. In the West Cumberland area prices are a shade weaker, Bessemer mixed numbers being quoted nearer £6 12s. 6d. than £6 15s. per ton delivered at Glasgow, Sheffield and Birmingham, and at £6 15s. f.o.b. Liverpool. For the special qualities of iron the demand is a trifle slacker, prices varying according to analysis.

MANCHESTER.—The general tendency of values for foundry iron in this district unquestionably points to lower levels in quotations, but at present the concessions obtainable are insufficient to induce buying beyond hand-to-mouth quantities. The local foundry trade is in urgent need of much cheaper pig-iron, but consumers will not buy at all at the current prices. The easing off of the Cleveland prices for pig-iron has not gone very far at present, but if the export demand is about to discontinue there can be no question that a substantial reduction in Cleveland prices must be near at hand. Scotch iron is certainly wanted in this district, but it is required at a lower price. In fact, that is the case with all this class of material, and Lancashire ironfounders are quite convinced that their business cannot improve until the prices for pig-iron are much lower.

THE MIDLANDS.—Decreased activity in new business is reported in pig-iron generally, and at Birmingham last week this tendency was again noteworthy. Smelters, however, are mostly well placed for contracts over the remainder of the current quarter, and consequently are by no means anxious so far as present outputs are concerned. Fuel conditions are, however, still too undetermined to prevent anything like substantial concessions in the values for forward business, and at present hardly hold out the possibility of very much lower levels in prices in the near future. Nominally quotations were unaltered, but smelters hinted that they were not invariably firm; that here and there where bookings were not quite so heavy an attractive inquiry would be met with concessions.

SCOTLAND.—Movements in the Glasgow pig-iron market have taken a much quieter turn, both as regards the home and export trade, while prices have receded to £5 17s. 6d. f.o.t., furnaces, and £6 2s. 6d. f.a.s. Glasgow, but there is practically no business being put through. There are numerous inquiries for small tonnages, but very few of these seem to result in business.

Finished Iron.

At Birmingham market last week manufacturers reported some falling-off in demand for finished material, which is partly explained by a renewal of Continental competition. This has, as usual, mainly affected the commoner qualities of bars, for which South Staffordshire makers have reduced quotations for nut and bolt iron to £11 10s., although the Lancashire price was not altered at 7s. 6d. more. These prices still leave a considerable margin above the Belgian figure, but local makers find it very difficult to make concessions as long as fuel and pig-iron remain so dear. Unless they obtain some substantial relief under these headings, the foreign competitor must soon have things pretty much his own way. Marked bar makers, fortunately, are well sold, and are keeping their mills well employed.

Scrap.

Dealings in the various markets for scrap material have been on a somewhat diminished scale of late, and values, consequently, disclose a slightly lower tendency. At Sheffield the demand is, of course, chiefly for heavy steel for melting, but it is stated that steel makers are declining to pay more than 97s. 6d. per ton, delivered, a drop of from about five shillings on recent quotations. Steel turnings also are rather easier, with fair supplies available at from 90s. to 95s. There is not much doing in iron scrap. Good wrought material holds at about 100s. In Lancashire the market for foundry scrap and broken cast iron is quiet, chiefly, no doubt, because so many ironfounders are short of work. It is admitted that founders need cheaper material, but it is rather unusual that scrap should be so cheap while foundry pig remains dear. There is a slight fall in foundry pig-iron this week, but it is trifling compared with what ironfounders expect, and most of them are holding back for a decline considerably greater, and this is no doubt the reason why they do not consider cast scrap at 95s. per ton to be cheap.

Metals.

Copper.—Movements in the standard copper market of late have developed a weaker tendency in values, home consumers hesitating in buying owing to the rather duller conditions of trade which have ruled since Easter. Meanwhile, on the Continent, the chaos in Germany resultant from the Ruhr occupation has brought with it a serious decline in German copper purchases. The policy initiated by the American copper producers in withholding the figures of output, etc., from the market has led to a suspicious feeling gaining ground, and while there are glowing reports sent over regarding the extraordinary American domestic consumption of copper and the strong statistical position, the fact remains that the price of electrolytic in New York has been easy. The recent decline is largely based on sentiment, and the market would very quickly respond to any influx of buying. Current quotations:—*Cash*: Wednesday, £69 15s.; Thursday, £70 17s. 6d.; Friday, £70 7s. 6d.; Monday, £70 10s.; Tuesday, £69 12s. 6d. *Three Months*: Wednesday, £70 12s. 6d.; Thursday, £71 12s. 6d.; Friday, £71 2s. 6d.; Monday, £71 5s.; Tuesday, £70 5s.

Tin.—A fair degree of activity has been experienced in the tin market for this metal during the past week, but prices have fluctuated to some extent, though with the statistical position fairly strong the tendency has continued reassuring. The actual statistics issued last week show that the total supply of tin now stands at 19,186 tons, against 21,544 tons last month, a decline of 2,358 tons. A year ago the visible supply stood at 21,049 tons, while on April 30, 1921, the figures were 15,217 tons only. Straits shipments for April only amounted to 4,620 tons, against 6,015 tons in the previous month. Shipments show a decline of close on 1,400 tons. The total monthly supplies were only 6,766 tons, while the deliveries amounted to 9,124 tons, or only 672 tons less than the big March total. Current quotations:—*Cash*: Wednesday, £215; Thursday, £215 10s.; Friday, £213 5s.; Monday, £210 5s.; Tuesday, £206 10s. *Three Months*: Wednesday, £215; Thursday, £215 10s.; Friday, £213 5s.; Monday, £210; Tuesday, £206 10s.

Spelter.—Increased production and reduced demands have had a depressing effect upon this metal, values having receded to lower levels than have been recorded for some time past. American consumption is quite likely to continue heavy for a good time yet under the pressure of domestic industrial activity; but there is no longer doubt that the world's production is gradually developing in excess of current trade requirements and that reserve stocks are gradually increasing. Current quotations:—*Ordinary*: Wednesday, £31 17s. 6d.; Thursday, £31 15s.; Friday, £31 15s.; Monday, £32 2s. 6d.; Tuesday, £31 16s. 3d.

Lead.—The market for soft foreign pig continues quiet, with demand poor and visible supplies more than ample to meet current requirements. The depression on the Continent has aggravated the situation, and metal normally consumed there has been diverted to this country. Current quotations:—*Soft foreign (prompt)*: Wednesday, £25 15s.; Thursday, £25 15s.; Friday, £25 7s. 6d.; Monday, £25; Tuesday, £24 12s. 6d.

Messrs. Andre Citroen et Compagnie, motor car manufacturers, of Paris, have engaged the H. M. Lane Company, of Detroit, Mich., U.S.A., as foundry engineers to lay out and construct a new foundry for them in Paris.

Telephone: 21, Penistone. Telegrams: "Durranns, Penistone."

ESTABLISHED 1863.

JAS. DURRANS & SONS., LTD.

Phoenix Works, Penistone NEAR SHEFFIELD.

BLACKING
PLUMBAGO
CORE GUM
WHITE DUST
COAL DUST

Manufacturers of

FOUNDRY EQUIPMENTS.

Ladles, Cupolas, Fire Bricks, Ganister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

Write for illustrated catalogue on Blacking and Foundry Requisites, also for our latest Price List.

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,

FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.,

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.

CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

Established 1872. *Telegraphic Address: "Steel, Glasgow."*

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	69	12	6
Three months	70	5	0
Electrolytic	79	5	0
Tough	73	0	0
Best selected	73	0	0
Sheets	106	0	0
India	93	0	0
Wire bars	79	15	0
Do. May	79	15	0
Do. June	79	15	0
Ingot bars	79	15	0
H.C. wire rods	84	0	0
Off. aver., cash, Mar.	73	18	4
Do. 3 mths., Mar.	74	12	2½
Do. Settlement Mar.	73	18	1½
Do. Electro, Mar.	81	14	7½
Do. B.S., Mar.	77	7	9½
Aver. spot price, copper, Mar.	73	17	3½
Do. Electro, Mar.	82	0	0

Solid drawn tubes 14½d.
Brazed tubes 14½d.
Wire 11d.
Yellow metal rods 7½d.
Do. 4x4 Squares 9d.
Do. 4x3 Sheets 10d.

BRASS.

Solid drawn tubes 12¾d.
Brazed tubes 14d.
Rods, drawn 11½d.
Rods, extruded or rolled 7½d.
Sheets to 10 w.g. 11d.
Wire 10½d.
Rolled metal 10½d.

TIN.

	£	s.	d.
Standard cash	206	10	0
Three months	206	10	0
English	206	10	0
Bars	208	10	0
Chinese	205	10	0
Straits	211	10	0
Australian	211	0	0
Eastern	213	10	0
Banca	209	0	0
Off. aver., cash, Mar.	219	15	0
Do. 3 mths., Mar.	220	18	10½
Do. Sttlment, Mar,	219	15	0½
Aver., spot, Mar.	219	13	4

SPELTER.

	£	s.	d.
Ordinary	31	16	3
Remelted	30	0	0
Hard	27	5	0
Electro 99.9	36	10	0
English	32	10	0
India	28	10	0
Prime Western	32	2	6
Zinc dust	49	0	0
Zinc ashes	13	0	0
Off. aver., Mar.	36	15	4½
Aver., spot, Mar.	36	14	4¼

LEAD.

	£	s.	d.
Soft foreign ppt	24	12	6
English	26	0	0
Off. average, Mar.	28	15	1½
Average, spot, Mar.	28	16	3¾

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	41	0	0
Do. V.M. ex whf.	40	10	0
Dutch	41	0	0
Rods	48	0	0
Boiler plates	40	0	0
Battery plates	41	0	0

ANTIMONY.

	£	s.	d.
English regulus	30	10	0
Special brands	36	15	0
Chinese	26	10	0
Crude	24	0	0

QUICKSILVER.

Quicksilver £10 0 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% £13 2 6
75% £20 17 6
Ferro-vanadium—
35/40% 16/9 lb. va.
Ferro-molybdenum—
70/75% c. free 9/3 lb. mo.
Ferro titanium—
23/25%, carbonless 1/2½ lb.
Ferro-phosphorus, 20/23%, £29
Ferro-tungsten—
80/85%, carbon free 1/5½ lb.
Tungsten metal powder—
98/99% 1/10½ lb.
Ferro-chrome—
4/6% car. £24 0
6/8% car. £23 0
8/10% car. £22 0
Ferro-chrome—
Max. 2% car. £50 0
Max. 1% car. £60 0
Max. 0.70% car. £70 0
67/70%, carbonless 1/6½ lb.
Nickel—99%, cubes or pellets £135 0
Cobalt metal—98/99% 12/–lb.
Aluminium—98/99% £115
Metallic Chromium—
96/98% 4/6 lb.
Ferro-manganese (net)—
76/80%, loose £18
76/80%, packed £19
76/80%, export £20
Metallic manganese—
94/96%, carbonless 2/– lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% s. d. tungsten 2 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ⅛ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.
Bevels of approved sizes and sections 6d. lb.
If in coils 3d. lb.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel	5	0	0	5	5	0
Bundled steel & shrngs.	4	5	0	5	0	0
Mixed iron & steel	4	7	6	4	12	6
Heavy cast iron				4	10	0
Good machinery for foundries				4	10	0
Cleveland—						
Heavy steel				4	15	0
Steel turnings				3	7	6
Cast-iron borings				3	7	6
Heavy forge				5	7	6
Bushelled scrap				4	15	0
Cast-iron scrap				4	15	0
Lancashire—						
Cast-iron scrap				4	15	0
Heavy wrought				4	17	6
Steel turnings				3	12	6

London — Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	64	0	0
Brass (clean)	38	0	0
Lead (less usual draft)	22	0	0
Tea lead	20	0	0
Zinc	22	0	0
New aluminium cuttings	70	0	0
Braziery copper	55	0	0
Gun metal	50	0	0
Hollow pewter	170	0	0
Shaped black pewter	90	0	0

PIG-IRON.

N. E. Coast—
Foundry No. 1 130/–
Foundry No. 3 125/–
Forge No. 4 115/– to 117/6
Mottled —
Hematite No. 1 123/6
Hematite M/Nos. 122/6

Midlands—
Staffs. common —
„ part-mine forge —
„ „ foundry —
„ Cold blast, ord. 190/–
„ „ roll iron 200/–
„ basic —

Northants forge 97/6 to 100/–
„ foundry No 3 110/–
„ basic 115/–

Derbyshire forge 107/6
„ foundry No. 3 116/3
„ basic 115/–

Scotland—
Foundry No. 1 120/–
„ No. 3 117/6
Hematite M/Nos. 125/–

Sheffield (d/d district)—
Derby forge 111/–
„ foundry No. 3 118/6
Lincs. forge 110/–
„ foundry No. 3 115/–
„ basic 120/–
E.C. hematite 134/9
W.C. hematite 132/6
All d/d in the district.

Lancashire (d/d eq. Man.) —
Derby forge —
„ foundry No. 3 126/–
Northants foundry No. 3 —
Cleveland foundry No. 3 —
Staffs. foundry No. 3 —
Lincs. forge —
„ foundry No. 3 —
Dalzell, No. 3 134/6
Summerlee, No. 3 134/6
Glengarnock, No. 3 134/6
Gartsherrie, No. 3 134/6
Monkland, No. 3 134/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.
Bars (cr.)	£12 to 12	10	0
Angles	12	5	0
Tees to 3 united ins.	12	10	0
Nut and bolt	11	10	0
Hoops	15	10	0
Marked bars (Staffs.)	14	10	0
Gas strip	13	0	0
Bolts and nuts, ¾ in. × 4 in.	20	10	0
Steel—			
Ship plates	10	10	0
Boiler plates	14	0	0
Chequer plates	11	5	0
Angles	10	0	0
Tees	11	0	0
Channels	10	5	0
Joists	10	0	0
Rounds & squares 3 in. to 5½ in.	11	15	0
Rounds under 3 in. to ⅜ in.	11	10	0
Flats, over 5 in. wide and up	12	0	0
Flats, 5 in. to 1½ in.	11	5	0
Rails, heavy	10	10	0
Fishplates	14	10	0
Hoops (Staffs.)	13	0	0
Black sheets, 24 g.	14	12	6
Galv. cor. sheets, 24 g.	19	10	0
Galv. fencing wire, 8 g. plain	18	5	0
Rivets, ¾ in. dia.	14	15	0
Billets, soft	£9 to 9	5	0
Billets, hard	10	15	0
Sheet bars	£9/11/6 to 9	15	0
Tin bars	10	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 3½
Sheet	1 4½
Wire	1 4½
Rods	1 3
Tubes	1 6½
Castings	1 1½

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.
CHARLES CLIFFORD & SON, LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/4 to 1/10
To 18 in. wide	1/4½ to 1/10½
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6½ to 2/0½
Ingots for spoons and forks	9d. to 1/3
Ingots rolled to spoon size	1/– to 1/6
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	32.76
No. 2 foundry, Valley	31.00
No. 2 foundry, Birm.	27.00
Basic	32.77
Bessemer	32.77
Malleable	32.77
Grey forge	32.27
Ferro-manganese 80% delivered	125.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y, at mill	43.00
Bess. billets	45.00
O.-h. billets	45.00
O.-h. sheet bars	46.00
Wire rods	51.00
	Cents.
Iron bars, Phila.	2.82
Steel bars	2.50
Tank plates	2.50
Beams, etc.	2.50
Skelp, grooved steel	2.50
Skelp, sheared steel	2.50
Steel hoops	3.30
Sheets, black, No. 28	4.00
Sheets, galv., No. 28	5.25
Sheets, blue an'l'd, 9&10	3.25
Wire nails	3.00
Plain wire	2.75
Barbed wire, galv.	3.80
Tinplate, 100-lb. box	$6.00

COKE (at ovens).

Welsh foundry 40/– to 45/–
„ furnace 30/– to 35/–
Durham & North. fdy. 47/6
„ furnace 39/6
Other Districts, fndy 45/–to47/6
„ furnace 32/6 to 37/6

TINPLATES.

f.o.b. Bristol Channel ports.

I.C.Cokes,	20×14, box	25/–
„	28×20, „	50/–
„	20×10, „	37/9
„	18⅞×14, „	25/9
C.W.	20×14, „	23/6
„	28×20, „	47/6
„	20×10, „	32/9
„	18⅞×14, „	24/–
Terneplates	28×20, „	46/6

TUBES.

Up to and incl. 6 in.

Gas .. ..57½% } Tube prices
Water ..52½% } are
Steam ..47½% } now free.

SWEDISH IRON.

Bars, hammered basis sizes—Basis price £22 to £23

Rolled Ordinary—
Assortment .. } £ s. d.
Nail Rods— } 17 5 0
Square, round and flats .. } to 17 15 0

Keg Steel nom. £38 to £40
Faggot Steel nom. £30 to £32
Blooms—
Single welded .. £10 to £11
Billets—
Single and double welded .. .. £13 to £14
Pig-iron—
Grey, white or mottled £6 15 to £7 5 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
May 2	69	15	0	No change	
„ 3	70	17	6	inc.	22/6
„ 4	70	7	6	dec.	10/-
„ 7	70	10	0	inc.	2/6
„ 8	69	12	6	dec.	17/6

Electrolytic Copper.

May 2	79	5	0	No change	
„ 3	79	10	0	inc.	5/-
„ 4	79	10	0	No change	
„ 7	79	10	0	„	
„ 8	79	5	0	dec.	5/-

Standard Tin (cash).

May 2	215	0	0	inc.	40/-
„ 3	215	10	0	„	10/-
„ 4	213	5	0	dec.	45/-
„ 7	210	5	0	„	60/-
„ 8	206	10	0	dec.	75/-

Tin (English ingots).

May 2	215	0	0	inc.	40/-
„ 3	215	10	0	„	10/-
„ 4	213	5	0	dec.	45/-
„ 7	210	5	0	„	60/-
„ 8	206	10	0	dec.	75/-

Zinc Sheets (English).

May 2	43	0	0	No change	
„ 3	43	0	0	„	
„ 4	42	0	0	dec.	20/-
„ 7	42	0	0	No change	
„ 8	41	0	0	dec.	20/-

Spelter (ordinary).

May 2	31	17	6	dec.	5/-
„ 3	31	15	0	„	2/6
„ 4	31	15	0	No change	
„ 7	32	2	6	inc.	7/6
„ 8	31	16	3	dec.	6/3

Lead (English).

May 2	27	0	0	No change	
„ 3	27	0	0	„	
„ 4	26	15	0	dec.	5/-
„ 7	26	5	0	„	10/-
„ 8	26	0	0	dec.	5/-

AVERAGE MONTHLY PRICES OF EAST COAST HEMATITE MIXED NUMBERS F.O.T.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1915	.. 83 11	.. 88 6	.. 94 8	..107 0	..102 6	..101 3	.. 98 9	.. 98 7½	.. 96 6	..104 0	..124 1	..130 0	..106 11½
1916	..133 9	..140 0	..136 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..128 1½
1917	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6
1918	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6
1919	..122 6	..122 6	..122 6	..122 6	..179 2	..190 0	..197 6	..200 0	..200 0	..200 0	..200 0	..200 0	..171 4
1920	..220 0	..220 0	..240 0	..260 0	..260 0	..260 0	..260 0	..260 0	..260 0	..260 0	..260 0	..251 8
1921	..240 0	..220 0	..180 0	..180 0	..180 0	..160 0	..160 0	..160 0	..137 0	..127 6	..117 6	..104 6	..162 2
1922	.. 97 6	.. 91 7½	..100 0	.. 98 6	.. 97 1½	.. 94 7	.. 93 6	.. 90 9	.. 89 7	.. 91 10½	.. 93 0	.. 93 2	.. 94 5½

AVERAGE PRICES OF STEEL RAILS.

Year.	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1908	.. 6 2 6	.. 6 0 0	.. 6 0 0	.. 5 15 6	.. 5 15 0	.. 5 15 0	.. 5 15 0	.. 5 15 0	.. 5 15 0	.. 5 15 0	.. 5 15 0	.. 5 10 0	.. 5 16 3
1909	.. 5 5 0	.. 5 5 0	.. 5 5 0	.. 5 0 0	.. 5 5 0	.. 5 5 0	.. 5 5 0	.. 5 5 0	.. 5 5 0	.. 5 5 0	.. 5 5 0	.. 5 5 0	.. 5 5 0
1910	.. 5 5 0	.. 5 7 6	.. 5 7 6	.. 5 7 6	.. 5 10 0	.. 5 10 0	.. 5 10 0	.. 5 10 0	.. 5 10 0	.. 5 10 0	.. 5 10 0	.. 5 10 0	.. 5 8 11½
1911	.. 5 15 0	.. 5 15 0	.. 5 15 0	.. 5 12 6	.. 5 12 6	.. 5 12 6	.. 5 12 6	.. 5 12 6	.. 5 12 6	.. 5 12 6	.. 5 12 6	.. 5 12 6	.. 5 13 1½
1912	.. 5 13 1	.. 5 15 0	.. 5 15 0	.. 5 15 7	.. 6 1 6	.. 6 6 3	.. 6 7 6	.. 6 8 0	.. 6 11 3	.. 6 12 6	.. 6 12 6	.. 6 13 9	.. 6 4 4
1913	.. 6 15 0	.. 6 14 4½	.. 6 12 6	.. 6 12 6	.. 6 12 6	.. 6 12 6	.. 6 12 6	.. 6 12 6	.. 6 10 0	.. 6 10 0	.. 6 10 0	.. 6 10 0	.. 6 12 0
1914	.. 6 10 0	.. 6 10 0	.. 6 6 3	.. 6 0 0	.. 6 0 0	.. 6 0 0	.. 5 14 0	.. 6 2 6	.. 6 13 9	.. 6 12 0	.. 6 7 6	.. 6 7 6	.. 6 5 3½
1915	.. 6 10 6	.. 6 17 6	.. 7 5 0	.. 7 12 6	.. 7 12 6	.. 7 17 6	.. 8 17 6	.. 9 2 6	.. 9 2 6	.. 9 2 6	.. 9 7 6	.. 10 10 6	.. 8 6 6½
1916	..10 19 4	..11 0 0	..11 0 0	..10 18 9	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 9 10
1917	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6
1918	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6	..10 17 6
1919	..10 17 6	..13 7 6	..13 7 6	..13 7 6	..15 0 0	..15 10 0	..16 0 0	..16 10 0	..16 10 0	..16 10 0	..17 5 0	..14 12 11
1920	..18 15 0	..19 5 0	..20 7 6	..22 0 0	..23 0 0	..23 0 0	..24 0 0	..25 0 0	..25 0 0	..25 6 0	..25 0 0	..25 0 0	..22 18 11½
1921	..23 5 0	..20 4 0	..18 0 0	..17 0 0	..15 0 0	..15 0 0	..14 0 0	..14 0 0	..14 0 0	..11 12 6	..10 10 0	..10 0 0	..15 4 3
1922	.. 9 10 0	.. 9 10 0	.. 9 10 0	.. 9 10 0	.. 9 10 0	.. 9 10 0	.. 9 10 0	.. 9 0 0	.. 8 15 0	.. 8 15 0	.. 8 15 0	.. 8 15 0	.. 9 4 2

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
5, MURZBAN ROAD, BOMBAY.
1, LALL BAZAR, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

REGISTERED TRADE MARK
JUMPER

1, HONG KONG ROAD, SHANGHAI.
31, RAFFLES PLACE, SINGAPORE.
JAVA STREET, KUALA LUMPUR.
5, SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

IRON & STEEL SCRAP

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

93, HOPE STREET, GLASGOW.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 7 words per line. Minimum charge for one insertion 3/-.

SITUATIONS VACANT AND WANTED.

IRON FOUNDRY FOREMAN, for Locomotive Works in Manchester district; first-class man, with full knowledge of Locomotive work. State age, qualifications, and salary required.—Apply Box 454, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

ASSISTANT FOREMAN MOULDER wanted for Brass Foundry in North of England; must be experienced in large Liner Castings and have a general knowledge of Commercial work.—Write full particulars of experience, age and wage required, enclosing copies of recent testimonials, to Box 460, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOREMAN MOULDER required for a Scottish Steel Foundry; must be experienced in Green Sand work, competent to handle unskilled and semi-skilled labour; Foundry capacity, 100 tons per week; open shop; state age, experience, and salary required.—Apply Box 442, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRY MANAGER (age 36) desires position as Manager or Foreman; 23 years' experience of all branches of the trade; 12 years' special experience in production of high-grade Motor and Aero Castings in Iron, Aluminium, and Brass.—Box 448, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

AGENCIES.

AGENTS wanted for all parts of the country, on a commission basis, to sell a Refractory Lining for Cupolas, etc.; must have good connections amongst Iron and Steel Foundries.—Apply, giving full particulars, to Box 452, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

PARTNERSHIPS.

ACTIVE PARTNER required for Foundry and Engineering Business, with about £1,000 capital; required for extension.—Box 458, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

PUBLICATION.

ENGINEERING WORKS, FOUNDRIES and FOUNDRY PLANT.—Complete lists of the Engineers, Iron, Steel, Brass and Aluminium Founders in Great Britain and Ireland, and also classified lists of Manufacturers and Suppliers of all Foundry Plant and Requisites, is contained in "Ryland's Directory of the Colliery, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades." Published by Eagland & Co., Ltd., Bessemer House, Adelphi, London, W.C.2. Price 42s. bound in cloth, 52s. morocco, net.

MACHINERY.

MACHINERY, PLANT, &c.

Five 3 ft. 4 in. Cold Iron Band SAWING MACHINES, by Noble & Lund, with swivelling table.

Three 10½ in. CUTTING-OFF MACHINES, hole in spindle 13 in. diam.; by Clifton & Baird.

Multiple PUNCHING MACHINE, by Rushworth & Co.; capacity, 33 holes 17/32 in. diam. through plates 3/16 in. thick.

Two Horizontal Double Geared Steam WINCHES; pair of cyls. 7 in. diam., 12 in. stroke, drum 18 in. x 20 in. face; by Clarke, Chapman & Co., Ltd.

19 nearly new RIVETED STEEL CISTERNS, each about 8 ft. x 5 ft. x 4 ft. deep, plates about 5/16 in. thick, capacity about 1,000 gallons each; fitted with outlet and mild steel loose cover.

80 STEEL CISTERNS, 7 ft. x 5 ft. x 4 ft. deep; capacity about 875 gallons.

LOCO-TYPE BOILER, barrel 7 ft. 6 in. long x 3 ft. diameter; reinsure 80 lbs. pressure.

LOCO-TYPE BOILER, barrel 4 ft. 7 in. long x 3 ft. diameter; reinsure 80 lbs. pressure.

Catalogue of Stock Machinery, 6,000 Lots, Free on application. Inspection invited.

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

MACHINERY.—*Continued.*

TWO NEW RUMBLERS, strong and well finished; geared drive; £22. Root's Blower, large size, £7 10s., f.o.r.—Apply 554, Fishponds Road, Bristol.

FOR SALE.

Two 300-kw. Belliss B.T.H. LIGHTING AND TRACTION SETS, compound wound; in first-class order, with Condensing Plant and Switchgear.

Two 500-kw. Belliss B.T.H. ALTERNATOR SETS, 2,000 volts, single-phase (Engines will be sold separately if required), with Condensing Plant.

Four Babcock Land Type BOILERS, 8,500 lbs. capacity, 160-180 lbs. press.

One Mixed-pressure Belliss TURBINE, with 1,000-kw. single-phase ALTERNATOR (2-phase carcase), 2,000 volts, 60 periods; and 333-kw., 500 volt D.C. GENERATOR, connected tandem, complete with CONTRAFLO CONDENSER and MOTOR-DRIVEN PUMPS.

One MOTOR GENERATOR, 250 kw., comprising single-phase Synchronous Motor, D.C. Compound Generator, 200 kw., and D.C. Shunt Generator, 150 kw.

COUNTY BOROUGH OF CROYDON ELECTRICITY WORKS, FACTORY LANE, CROYDON.

VERTICAL BOILER, by Robey, 8 ft. 6 in. x 3 ft. 6 in., 80 lbs. w.p.; two new Weir Boiler Feed Pumps, 1,450 gallons per hour each; 5-ton Steel Hopper Wagons, 4 ft. 8½ in. gauge; two "Tangyro" Belt-driven Pumps, 3 in. and 7 in. delivery, new; 31 h.p. latest type Crossley Gas Engine, 6-k.w. Steam Generating Set, 110 volts D.C.; two Low Lift Centrifugal Pumps, by "Sulzer," 50,000 gallons per hour, 75 ft. head, 220 volts D.C.—HARRY H. GARDAM & COMPANY, LIMITED, Staines.

WANTED, Moulding Machine, by Darling & Sellers, or similar make; one disused or worn out will be considered.—State full particulars and lowest price, Box 456, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

PATENTS.

INVENTORS Advice, Handbook and Consultations Free. KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Regd. Patent Agent, 146a, Queen Victoria Street, London; 36 years' references.

MISCELLANEOUS.

FILES.—Twenty tons of New Files by best American makers. Flat, Hand, Round, Square and Three-square in bastard; second cut and smooth; surplus stock; no reasonable offer refused.—Box 368, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

ENQUIRIES SOLICITED FOR PATTERNS; quotations by return. Our works are well-equipped for turning out good work at reasonable prices. Castings also supplied, if required, in all metals.—E. CLEGHORN, Pattern Works, St. Martin's Gate, Worcester.

CASTINGS.

Modern Foundry equipped for weights up to 10 or 12 tons. Keen prices. Best quality.

Enquiries solicited for pattern making. Good deliveries.

Wm. ASQUITH (1920), Ld.
Highroad Wells Road - - - - HALIFAX

SAND PLANT.

NEW SMEDLEY sand mill, with fixed pan 6 ft. 6 in. dia., 24 in. deep, **£55**, on rail at Nottingham.
7 FT. SAND MILL, with revolving pan and plain rollers, in good condition. **£50**, f.o.r. Coventry.
6 FT. SAND MILL, by Jackson, revolving pan, plain rollers, 36 in. dia., 15 in. face, fitted new false bottom, new shafts, thoroughly overhauled in my own workshop. **£50**, f.o.r. Slough.
4 FT. SAND MILL, stationary pan, self-emptying, plain rollers, in serviceable condition. **£22**, Slough.
WERNER TYPE MIXER, equal to new. **£32**, Slough.
PNEUMATIC SAND SIFTER, by Macdonald. **£10.**
BELT-DRIVEN SAND SIFTER. **£8.**

BRASS FOUNDRY PLANT.

GIT CUTTER, by Roberts, to cut 3 in. square. **£25.**
MAGNETIC SEPARATOR, by Evans. **£20.**
SAND BLAST PLANT, by Tilghman, complete. **£48.**
BAND SAW, for brass, by Noble & Lund. **£28.**
250 PAIRS OF BOXES, 18 in. x 8 in., interchangeable. **6s.** pair.
SIX Morgan 400-lb. capacity TILTING FURNACES. Price **£45** each.
ENQUIRIES SOLICITED. LARGE STOCKS HELD.
Send for Catalogue.

ALEX. HAMMOND, Foundry Machinery Merchant, "BOXTED," SLOUGH.